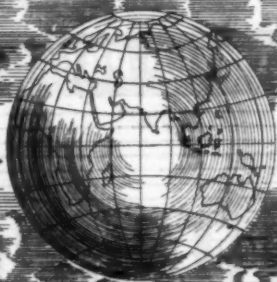


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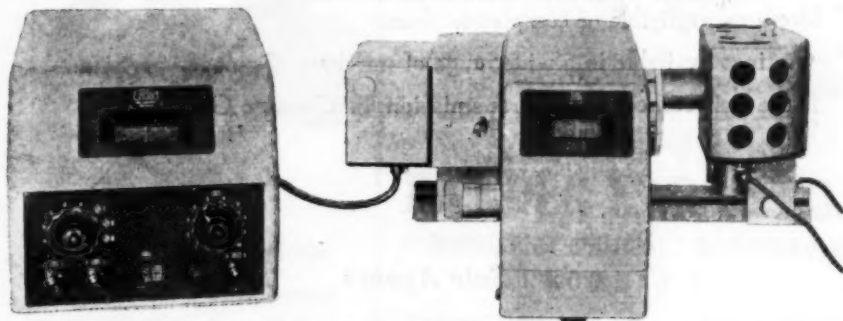
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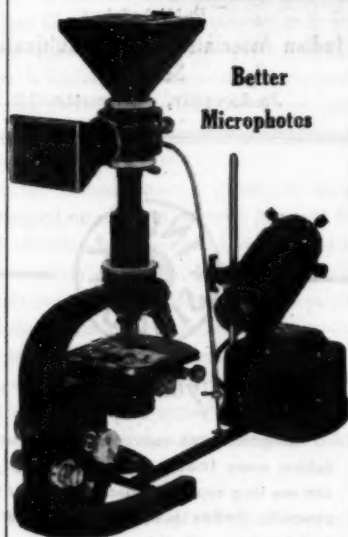
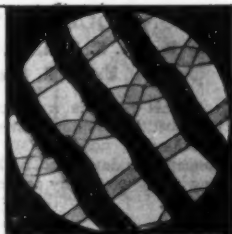
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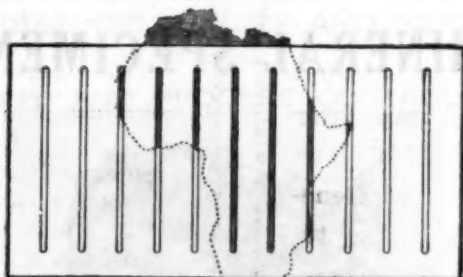
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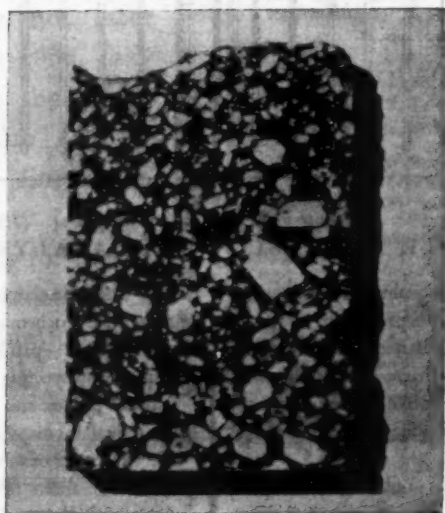
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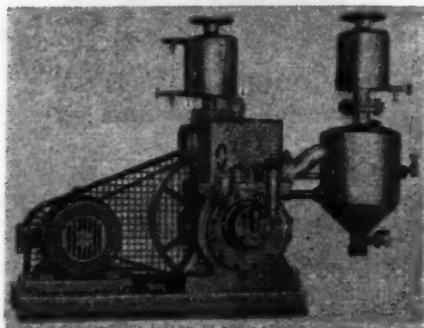
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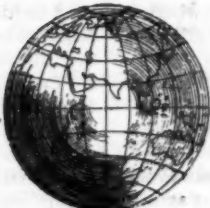
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# Current Science



Vol. XXV]

APRIL 1956

[No. 4

	PAGE		PAGE
Training and Research in Applied Mathematics .. ..	103	Letters to the Editor .. ..	111
Electronic Computers in Scientific Research .. ..	104	Release of Energy from the Atmosphere at High Altitudes .. ..	130
Treatment of Infectious Hepatitis ..	105	Reviews .. ..	131
The Embryology of Angiosperms, A Retrospect and Prospect—P. MAHESHWARI .. ..	106	Applied Biology—N. L. DUTT ..	136
		Science Notes and News .. ..	137

## TRAINING AND RESEARCH IN APPLIED MATHEMATICS

WHILE the role of mathematics as the Queen of the Sciences is easily conceded and very well understood, there is a great deal of confusion in the minds of many workers regarding the role played by applied mathematics in science and engineering. Applied mathematics is fast emerging as a separate discipline, with its own characteristic approach to various problems, quite distinct from the methods of pure mathematics. It is high time that courses of study are offered in our Universities, at least at the post-graduate level, where some directed study may be made of the applied aspect of mathematics in physical, technical and biological sciences. An obvious corollary to this is the need for establishing one or more computatorial centres, where modern high speed calculating machines would be developed and could be utilised by workers in applied mathematics. In this connection the following memorandum prepared by Prof. B. R. Seth and circulated amongst the members who attended the South Asian Conference on Mathe-

matical Education held in Bombay recently deserves careful study.

Mathematics is applied if conceived in a spirit of ready co-operation with other sciences in the great endeavour of comprehending our environment, and of bringing order and scientific basis into this study. It should be original and imaginative in the invention and use of its concepts. Unlike pure mathematics it shows in its conceptual activity a deep interest in the world of outer experience and enriches mathematics with structures closely related to or suggested by experience and observation. In this respect Indian Mathematics has so far failed to make a signal contribution.

The following developments have revolutionized the concept of applied mathematics: (i) Axiomatic approach; (ii) Uncertainty principle as illustrated in statistical mechanics, quantum mechanics and modern bio- and sociological phenomena; (iii) Industrial competition and military rivalry; (iv) High speed electronic computers. The next ten years will see



intensive mathematisation of fundamental scientific and engineering research, managerial functions, conduct of military operations, planning of economic affairs and even human thought. These years will also decide whether applied mathematics will remain an effective component in the great mathematical, community, or will emerge as an independent scientific enterprise.

In U.S.A. there are at present seven mathematical institutes and two University departments specifically dedicated to the cultivation of applied mathematics. In India the Calcutta University has a full-fledged department of applied mathematics, but otherwise those taking interest in some branch of applied mathematics are not many. This is in striking contrast to what is happening in the United States of America, where mathematics is playing a very vital role in all spheres of human activity. The reasons for such a state of affairs are:

(i) The courses in mathematics are heavy and have not been integrated with other scientific subjects to make them attractive and beneficial to the students in the long run. (ii) The avenues open to mathematicians have not been fully explored and publicized. (iii) The curriculum in graduate education seldom leads students to take an interest in higher work. (iv) Industry and national research laboratories have not been made fully aware of the important role which mathematics is to play in their development. (v) No practical bias is given to graduate education to enable a number of students to find suitable employment in business and industry.

Thus there is lack of qualified students, qualified teachers and suitable publicity.

At present mathematics is taught indifferently in technical institutions. This has proved very harmful to the development of the subject, and it is to be feared that national plan-

ning for higher grade technical training may not be successful unless mathematics plays its fundamental role.

With this end in view a joint symposium of the Sections of Mathematics, Statistics and Engineering at the Forty-Second Meeting of the Indian Science Congress at Baroda set up a Committee under the Chairmanship of Prof. B. R. Seth, consisting of three engineers, two mathematicians and two statisticians to make recommendations on the teaching of mathematics in engineering institutions. Its report was discussed at the Forty-Third Meeting of the Indian Science Congress held at Agra and the final report is under preparation.

The following recommendations, if adopted, may help to improve the present state of affairs:

- (i) Establishment of a National Committee on Applied Mathematics. This will facilitate co-operation between Institutes and Universities, will call attention to new areas in which mathematics can be profitably used and will do a periodical survey of problems concerned with training and research in the subject.
- (ii) Establishment of graduate schools.
- (iii) Provision of an increasing number of optional papers in applied mathematics for the B.A. (Hons.) and M.A. Examinations in our Universities.
- (iv) Encouragement to students to take courses in other sciences with a significant mathematical content.
- (v) Invitations to mathematicians from industries and Government to teach at Universities and take part in their research activities on a temporary basis.
- (vi) Provision for employing mathematicians on the staff of industries and national laboratories to help them in their problems of production and research.

### ELECTRONIC COMPUTERS IN SCIENTIFIC RESEARCH

THE importance attached to the use of modern electronic computers in molecular quantum mechanics has been stressed in an International Conference held in Texas during December last. A resolution was passed unanimously, directing attention to the impressive results already obtained by high speed computers in the calculation of molecular and crystal properties, and claiming that these properties are of extreme importance in chemistry, physics

and biology. The resolution goes on to note that "progress of this work is greatly hampered by the fact that, due to their great cost, high speed computers are unavailable to most scientists in this field"; and therefore it "recommends that governments, industries, foundations and private philanthropists give special attention to the problem of providing more high speed computing facilities for use in molecular problems". Copies of the complete document

are being sent to government and other scientific agencies in Britain, the United States and elsewhere.

Regarding the provision of a limited number of these computers by the University Grants Committee during the next quinquennium in Great Britain, *Nature* observes that it would be a great pity if the number is unrealistically small. For, electronic computers have entirely changed the kind of problem (such as the structure of vitamin B<sub>12</sub> or a single protein molecule) which can be attacked successfully. As things are now, certain calculations have to

be sent from Britain to the United States, since they cannot be dealt with adequately in British Universities. One American firm alone expects to have nearly two thousand large computers in use at the end of another eighteen months or so. A similar situation is present in our country also, and some research workers, particularly in the field of crystallography, have to send their more extensive calculations to the United States for being worked out. It is imperative that a start should soon be made towards establishing a computational centre in India.

### TREATMENT OF INFECTIOUS HEPATITIS

It is only fifteen years since the exact pathology of epidemic jaundice was determined and the idea of "catarrhal jaundice" gave way to that of "infectious hepatitis". In the absence of any specific remedy against the virus of infectious hepatitis, the application of recent knowledge of the liver's nutritional needs underlies the treatment of the disease. The earlier starvation diet is not altogether agreed upon. Whether protein should be given in excess or in only normal amount, whether fat should be restricted, whether exercise is bad for the liver—these are some of the questions which the physician may ask, and it is not possible to answer them at all dogmatically.

The value of a liberal diet, especially one containing much protein, is in keeping with observations made in Britain. But the benefit from a diet high in protein, when compared with that from a diet containing moderate or even small amounts of protein, is not remarkable, for it must be remembered that the experiments have always been carried out on adequately nourished patients, well able to stand up to what, in most instances, is a mild illness. Liberal feeding in hepatitis is not specific in the way that antibiotics are specific for many bacterial infections. It is known that protein, and in particular the amino acids, methionine and choline, are necessary for the health of the liver. The aim of liberal feeding is to ensure that the materials for repair are present in abundance.

There is no evidence that fat is harmful, and if the patient can manage it a balanced diet

containing a normal amount of fat is probably best.

The findings of Chalmers *et al.* that early activity had no harmful effect on the course of the disease is contrary to the usual teaching. But here, again, the patients studied were healthy and well fed before they fell ill. They were admitted to hospital, and, though they were not kept in bed, their activities were restricted. The problem is very different when the patient is a housewife with a house and young family to care for single-handed. The amount of work she must undertake is considerable, and it is in such circumstances that infectious hepatitis is likely to be prolonged and serious relapses may occur. Rest in bed should then be continued until the level of serum bilirubin has returned to normal.

In addition to a liberal diet many other substances, including amino acids, hormones and vitamins, have been tried in an endeavour to hasten recovery. Methionine and choline, amino acids containing sulphur, have no demonstrable effect. Insulin has been given in combination with a diet high in carbohydrate, but it is probably wiser to give carbohydrate alone.

On the whole it would appear that the average patient will do well on a commonsense regimen of rest with as liberal a diet as he can take. But when the illness is severe something more is needed; the most useful additions are large quantities of carbohydrate and vitamins of the B group—(*British Medical Journal*, Feb. 18, 1956, p. 389.)

## THE EMBRYOLOGY OF ANGIOSPERMS, A RETROSPECT AND PROSPECT

P. MAHESHWARI

Dept. of Botany, University of Delhi

THERE have been three periods in the history and progress of angiosperm embryology; the first in which several observers began to examine dissections, hand sections and later microtome sections of anthers and ovules under the microscope and gradually collected a mass of valuable information on the development and organization of the gametophytes, endosperm and embryo; the second in which such studies began to be undertaken on a comparative basis so that the data obtained could be used for taxonomic purposes; and the third and most recent in which embryology has become an experimental science having intimate contacts with physiology and genetics.

## DESCRIPTIVE EMBRYOLOGY

Among earlier workers the names of Amici, Schleiden, Hofmeister, and Hanstein are the most prominent. Amici (1824) discovered the pollen tube and later (1830) traced it to the mouth of the ovule. Schleiden (1837) followed its growth in many plants and established its occurrence as a general phenomenon in angiosperms. However, his enthusiasm for discovery and an innate keenness to be the first in everything led him to a grievous error, for he imagined having seen the tip of the pollen tube converting itself into the embryo. In the lively and sometimes rather heated controversy which followed, botanists divided themselves into two camps: some supporting Schleiden and others upholding the views of Amici who claimed that a "germinal vesicle" present inside the embryo sac gives rise to the embryo although the stimulation to its development was no doubt supplied by the pollen tube. To decide the question a prize was announced by the Imperial Institute of the Netherlands at Amsterdam. This was awarded to H. Schacht who wrote a large monograph with numerous figures all supporting the mistaken interpretations of Schleiden!

The issue was settled by the careful researches of W. Hofmeister (1849) who published a famous paper entitled "Die Entstehung des Embryo des Phanerogamen". Here he described his observations on 38 species belonging to 19 genera and showed that without exception the embryo originates from a pre-existing cell in the embryo sac and not from the pollen tube.

An exceptionally keen observer, Hofmeister also figured the reduction divisions in the pollen mother cells of *Tradescantia* although he could not correctly interpret the complicated series of changes undergone by the chromosomes. Elfving (1829) established the nature of the nuclei in the pollen grain and Strasburger (1884) demonstrated that the stimulation provided by the pollen tube is of a material and not merely a chemical nature. He succeeded in observing the fusion of the male and the female gametes in *Monotropa hypopitys* and since a similar demonstration had by now been made in many lower plants and animals, there remained no doubt that the essential feature of fertilization is the fusion of the two sexual nuclei.

Meanwhile, several investigators had joined the chase. To mention a few, Hanstein (1870) gave a very detailed account of the development of the embryo in *Capsella* and *Alisma*. Strasburger (1878, 1879) traced the origin of the adventive embryos of *Hosta* and the development of the female gametophyte of *Polygonum*. Hegelmaier (1887) published a comparative account of the histology of the endosperm in many dicotyledons, and Treub (1891) announced his discovery of chalazogamy in *Casuarina*. With the rich collection of tropical plants in the botanical gardens and environs of Buitenzorg ready at hand, Treub also published several outstanding papers on the Lorantheae, Orchidaceae and Burmanniaceae.

In this gamut of new data, there was one vexing phenomenon. Since the pollen tube always brings two male gametes and only one fertilizes the egg, the problem remained as to what happens to the second male gamete. Also, what caused the renewed activity in the embryo sac leading to the formation of a large nutritive tissue, the endosperm? Nawaschin (1898) and Guignard (1899), working independently and using almost identical material, made the interesting discovery that in angiosperms we have a "double" fertilization, one male gamete fusing with the egg and the other with the two polar nuclei.\* This immediately provided the explanation for xenia and with the discoveries of Juel (1900) and Murbeck (1901) of the

\* For further details on the historical aspects of angiosperm embryology, see Baranov<sup>1</sup> and Souèges.<sup>2</sup>

parthenogenetic development in *Antennaria* and *Alchemilla*, the stage was now set for a generalized and connected account so ably written in 1903 by Coulter and Chamberlain. This was followed 26 years later by the publication of Schnarf's well known "Embryologie der Angiospermen" which remains a mine of information to this day.

Among the hundreds of papers published during the last 50 years mention must first be made of the very painstaking studies made by Souèges and Crété on the embryology of a very large number of genera and species belonging to various families. Wulff in Germany and Finn and his pupils in Ukraine have published a series of papers on the male gametophyte from which they conclude that the generative nucleus is always surrounded by its own sheath of cytoplasm, that normally the sperm nuclei also have their own sheaths, and that not only the male nucleus but the male cytoplasm also takes part in fertilization. There is no conclusive proof yet that the sperm cell enters the egg as such, but Wylie's (1941) studies on *Vallisneria* are quite suggestive of such an occurrence.

Concerning the development of the embryo sac we have a mass of literature at present, some of the principal contributors being Johnson, Geerts, Lagerberg, Dahlgren, Palm, Bambacioni, Håkansson, Cooper, Stenar, Johri, Fagerlind, Harling, Swamy and Subramanyam. Their studies have led to the correction of many old errors and emphasized the necessity of having a close series of stages before coming to any definite conclusions. To mention an example, the embryo sacs of species of *Lilium* and *Fritillaria* were studied many times by such masters as Guignard, Mottier, Sargent, Coulter and others and the material was repeatedly employed for class demonstration; yet, it was only in 1928, as the result of Bambacioni's brilliant work on *Fritillaria persica* and *Lilium candidum*, that the correct sequence of stages was understood. This led to the re-investigation of a number of plants which were previously supposed to fall under the *Lilium* or *Adoxa* type, resulting in much valuable information which has been reviewed elsewhere.<sup>3</sup>

The phenomena of apomixis and polyembryony have always attracted a good deal of attention. It was an apomictic *Hieracium* which baffled Mendel and many years passed before it became clear as to why the "pea laws" failed to apply in this case. Today several embryologists are engaged in studying the

methods of origin of non-haploid embryo sacs and of embryos from cells other than the egg.

Another recent and attractive line of research is the study of pollen tubes not only in the fixed but also in the living condition with the use of the phase microscope (see Steffen<sup>4</sup>). Of considerable interest to the cytologist are also the anther tapetum and the endosperm whose nuclei show many peculiarities in the behaviour of the chromosomes.

#### PHYLOGENETIC EMBRYOLOGY

It is a matter of common knowledge that external appearances of vegetative organs may sometimes lead to wholly incorrect ideas of relationships. Even experienced botanists have occasionally mistaken a leafless asclepiad for a species of *Ephedra*. The taxonomist, therefore, places greater reliance on the flower which is a more conservative organ than the root, stem or leaf. But if we assume phylogenetic trends in the external morphology of the flower, why not in the internal structures such as pollen, embryo sac, endosperm, and embryo, which are more protected from environmental influences and are therefore expected to be still more conservative. The appearance in 1931 of Schnarf's "Vergleichende Embryologie der Angiospermen" first brought to light the important role of embryology in taxonomical considerations.

The Cactaceae, Callitrichaceae and Empetraceae are well known examples of families whose systematic position has often been disputed in the past. Embryology has given a clear lead in all the three cases and it is now generally agreed that the Cactaceae belong to the Centrospermales, Empetraceae to the Ericales, and Callitrichaceae to the Tubiflorae.<sup>5</sup> On embryological as well as other grounds *Trapa* should be removed from the Onagraceae and placed in a separate family, Trapaceae. *Calochortus* with its monosporic 8-nucleate embryo sac is to be removed from the tribe Lilioideae (Liliaceae) and *Gagea* with the *Fritillaria* type to be transferred to the Lilioideae.

While numerous examples can be cited of the value of embryology in helping us to decide between two alternative views of the relationships of a particular group of families, we shall confine ourselves here to a few on which work has been done in this country.

In many parts of India we have a marshy plant, *Sphenoclea zeylanica*, which is specially common in rice fields. This has usually been placed in the Campanulaceae, but Airy Shaw<sup>6</sup> has recently suggested that the habit and anatomy show several significant features found



in the Phytolaccaceæ while other characters suggest the Primulaceæ. As a result of the work of Subramanyam<sup>6</sup> it has now been shown conclusively that *Sphenoclea* has no close connections with either the Phytolaccaceæ or the Primulaceæ.<sup>7,8</sup> On the other hand, the resemblances with the Campanulaceæ-Lobeliaceæ are so pronounced and unmistakable that Airy Shaw's view must be set aside.

Table I, which summarizes some of the anatomical and embryological characters of Phytolaccaceæ, Campanulaceæ and Sphenocleaceæ, clearly brings out the resemblances between the Campanulaceæ and Sphenocleaceæ.

TABLE I

Characters	Phytolaccaceæ	Sphenocleaceæ	Campanulaceæ
1 Anomalous secondary growth	Present	Absent	Absent
2 Ovule	Ana-campylotropous, bitegmic	Anatropous, unitegmic	Anatropous, unitegmic
3 Nucellus	Massive: persists as peri-perm	Very thin and ephemeral	Very thin and ephemeral
4 Nucellar epidermis	Produces secondary parietal tissue	Destroyed by the developing embryo sac	Destroyed by the developing embryo sac
5 Endothelium	Absent	Present and conspicuous	Present and conspicuous
6 Endosperm	Free nuclear, haustoria absent	Cellular, with well-developed haustoria	Cellular with well-developed haustoria

The family Lemnaceæ consists of four genera in all, of which the flowers are so minute that they are easily overlooked. Recent work based on abundant flowering material of *Wolffia microscopica* and *Lemna paucicostata*<sup>9,10</sup> shows that the anther tapetum forms a periplasmodium, the pollen grains are 3-nucleate, the ovule is orthotropous, the embryo sac is of the Allium type, the endosperm is Cellular with a basal haustorial process, and the proembryo is without a large basal cell. One layer of endosperm cells persists in the seed and the micropyle is formed by the outer integument. In the Helobiales, with which Lawalrée<sup>11</sup> considers the Lemnaceæ to be closely allied, the micropyle is formed by the inner integument, the endosperm is free nuclear or Helobial, the proembryo has a large basal cell with dense cytoplasm and a hypertrophied nucleus, and the seed is exalbuminous. These differences are sufficiently marked to preclude any direct relationship between the two groups. On the other hand, there are significant similarities between the embryological characters of the Lemnaceæ and the Araceæ which support the usually accepted view that the Lemnaceæ have their closest allies in the Araceæ.

The genus *Exocarpus* comprises about 17 species, mostly Australian. Recently it has come

into some prominence owing to a suggestion of Gagnepain and Boureau<sup>12,13</sup> that it should be assigned to a separate family Exocarpaceæ to be transferred to the gymnosperms near the Taxaceæ. The case for this transfer rests on the "naked" ovule, articulated pedicel (re-calling *Podocarpus* and *Acropyle*) and the presence of a pollen chamber. In his annual review of "Systematik der Spermatophyta" in *Fortschritte der Botanik* Suessenguth (1954) writes: "Da der Embryosack von *Exocarpus* bisher nicht bekannt ist, ist nach Ansicht des Ref. eine endgültige Beurteilung der Frage noch nicht möglich, wenn schon andere stärke

Übereinstimmungen von *Exocarpus* mit wirklichen Santalaceen sowie die eindeutige Angiospermie der Eu-Santalaceæ zunächst gegen die Annahme von Gagnepain und Boureau sprechen."

An embryological study carried out by Maheshwari and Ghosh<sup>14</sup> on *Exocarpus spartium* and *E. cupressiformis*, material of which was very kindly provided by Miss I. Cookson of Melbourne and Dr. H. S. McKee of Sydney, has shown that the plant is an undoubted angiosperm. No abnormalities were noticed in the development of the anther and the male gametophyte. There is a fibrous endothecium as in other angiosperms and the pollen grains are shed at the 2-celled stage. The ovule is orthotropous. The megaspore mother cell gives rise to a row of three cells of which the chalazal functions. The mature embryo sac is 8-nucleate with the usual angiospermic organization but differs from the other members of the Santalaceæ in not having the U or N form. The first division of the zygote is transverse. Subsequent divisions result in a long filament of cells which later produces the usual dicotyledonous embryo. There are indications of cleavage polyembryony resulting from a proliferation of the suspensor. In the development of the endosperm of *E. spartium* the primary



chalazal chamber becomes elongated and divides vertically into two cells each with a hypertrophied nucleus while the micropylar chamber shows repeated cell divisions and forms the main body of the endosperm.

The occurrence of 2-celled pollen grains, a normal 8-nucleate embryo sac, post-fertilization endosperm and division of the zygote by wall formation definitely prove that *Eriocarpus* is an angiosperm although it may be regarded as an aberrant member of the Santalaceae.

#### APPLIED AND EXPERIMENTAL EMBRYOLOGY

Coming now to the comparatively new field of applied and experimental embryology, a fair amount of work has been done on the viability, storage and conditions of germination of pollen; the rate of pollen tube growth; and the inactivation of incompatibilities between the male and female gametes. Considerable success has also been achieved in the artificial stimulation of the ovary resulting in the development of seedless fruits and this has now become a standard practice in some countries in the cultivation of out-of-season tomatoes in glass-houses. Workers in California have also found it possible to eliminate the caprification (pollination) of calimyrna figs and ripen them by treatments with *para*-chlorophenoxyacetic acid or *para*-fluorophenoxyacetic acid.<sup>15</sup> Recently Nitsch<sup>16</sup> has successfully grown pollinated ovaries of tomato, tobacco, strawberry, bean and some cucurbits in artificial media, and those of tomato and gherkin ripened even to the extent of producing viable seeds. The growth of unpollinated ovaries was arrested but the addition of hormones to the culture medium enabled those of tomato to develop into parthenocarpic fruits.

An important aspect of experimental embryology is the artificial culture of excised embryos. This is of considerable interest to the plant breeder and the horticulturist: (1) it enables the rearing of hybrid embryos which may otherwise be doomed because of the "baneful" influence of the maternal tissues; (2) it affords a means of making quick tests of the viability of seeds; and (3) by this method it is possible to bypass the period of dormancy and reduce the time required for growing a plant to maturity. To the physiologist it is important as a tool for understanding the nutritional requirements of the growing embryo.

In general, the older the embryo the easier it is to excise it and culture it in an artificial medium. The chief difficulty lies in growing

young embryos not only because of possible injury to their tissues during dissection but also because their nutritive requirements are much more complex than those of larger embryos. About 15 years ago Van Overbeek and his co-workers introduced the use of coconut milk in the culture media but the results obtained were erratic and later it was found that Seitz-filtered malt extract is an effective substitute for coconut milk. However, no detailed analysis has yet been made of the particular component ("embryo factor") of coconut milk or malt extract which provides the stimulus for the growth of the embryos. Another point is that in culture young embryos do not always follow the normal course of development and differentiation. Not only is their growth slowed down, but there are often swellings, fasciations, formation of irregular bud-like growths and a premature differentiation of the radicle and plumule.

While some success has been achieved in the artificial culture of embryos and even anthers<sup>17,18</sup> there are a few other problems whose solution has so far defied all attempts. One is the induction of artificial parthenogenesis. This is of great interest to the breeder as a method of obtaining homozygous strains in two steps only instead of repeated selfing carried out for a number of generations. For, once we learn how to cause the haploid egg to form an embryo, it would be easy to double the number of chromosomes by treatment with colchicine. Several methods, both physical and chemical, have been tried to stimulate the egg. Among those most frequently quoted are exposure of the plants at critical periods to temperature extremes and other shocks; pollination with dead, X-rayed or foreign pollen; and chemical treatments; but the results obtained are inconclusive and the percentage of success is generally of little statistical significance. Further, even if the egg can be made to divide, it is much more difficult to initiate endosperm formation; and without the metabolites formed by the endosperm the embryo is unable to grow to maturity.

Of interest are also the adventive embryos found in *Citrus*, *Mangifera*, *Eugenia* and several other genera. They have the same genetical composition as the maternal parent, and are therefore of considerable value as a means of propagation of desirable varieties of fruit trees. Attempts to stimulate the production of adventive embryos in those plants, which do not normally have them, have however proved unsuccessful. Injections of hormones into the ovules cause the production of tumours from the

integumentary tapetum but no one has so far been able to grow them in artificial media and obtain seedlings from them.

The phenomenon of cleavage polyembryony is common in gymnosperms but not so in angiosperms where normally the egg gives rise to a single embryo. Since identical twins are useful in a study of the effects of heredity vs. environment, a method of inducing them is desirable. Recently Eunus<sup>19</sup> exposed developing seeds of *Hordeum vulgare* to X-rays. The embryos grew more slowly and often showed a number of proliferations but it remains to be seen whether they can be cultured to give rise to independent seedlings. In many members of the Ranunculaceae the seeds contain a rudimentary pear-shaped embryo in which the cotyledons are differentiated considerably after shedding. Haccius<sup>20</sup> treated fresh seeds of *Eranthis hiemalis* with undifferentiated embryos with a 0.1% aqueous solution of 2,4-dichlorophenoxyacetic acid. This caused the production of twin embryos in 3-8% of the seeds whereas the normal frequency of twinning is less than 0.3%. The twins are invariably fused at the radicular end but can be separated and grown to maturity in artificial media.

#### CONCLUSION

Considerable progress has been made in the descriptive and phylogenetic aspects of plant embryology, ever since Amici began his study of pollen tubes, but many families, particularly tropical, need further study. While no classification can be based on any one structure such as the embryo or endosperm, there is no doubt that a proper evaluation of all the data will prove useful in a better understanding of the interrelationships of many genera and families and in an improvement of the existing schemes of classification. Much less has, however, been done on experimental embryology as also pointed out by Wardlaw<sup>21</sup> in his excellent book on "Embryogenesis in Plants". This is no doubt due to the inaccessible position of the embryo in higher plants. Nature has put cunning safeguards upon the embryo in the form of multiple envelopes of several cell layers which must be crossed before it is possible to reach it. It is hoped that the technical difficulties involved in this process will be gradually conquered. While experimental studies cannot stand alone and a basic training in descriptive morphology is essential, it is desirable that the plant embryologist of the future, like his counterpart on the zoological side, should also have some fami-

liarity with physiological and biochemical methods. It is only sustained effort on these lines that will lead to a clear understanding of the complexity of the organismal phenomena involved in the origin, growth and differentiation of the embryo.

(In order to conserve space the older papers are not cited here. Reference to them will be found in Ref. 3.)

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## LETTERS TO THE EDITOR

	PAGE		PAGE
Dielectric Behaviour of Mixture of Polar Gases at Microwave Frequencies—G. P. SRIVASTAVA .. .. .	111	A Preliminary Note on the Pharmacology of Evolvine—M. N. GURUSWAMI, T. R. KRISHNAMURTHY AND T. S. VAIDYANATHAN .. .. .	119
The Heat and Specific Heat of Mixing of He <sup>3</sup> and He <sup>4</sup> Solutions—BIPIN KUMAR AGARWAL .. .. .	112	Some Abnormalities in the Venous System of Rana tigrina Daud.—S. C. SHARMA .. .. .	120
The Elastic Scattering of 90 Mev Neutrons by Copper—G. Z. SHAH AND K. M. GATHA .. .. .	113	Occurrence of Johnius hololepidotus (Lacépède) in Indian Waters—G. SESHAPPA .. .. .	121
Kaemmererite from Sindhuvali Mines, Mysore District—M. N. VISWANATHIAH .. .. .	114	B-Chromosomes in Panicum coloratum—M. S. SWAMINATHAN AND JOGINDER NATH .. .. .	123
Unit Cell and Space Group of Cupric Ammonium and Potassium Oxalates—M. A. VISWAMITRA AND R. V. G. SUNDARA RAO .. .. .	115	Carotenoid in Pila virens (Lamarck)—(Miss) V. R. MEENAKSHI .. .. .	124
Correlation between Conductivity, Swelling and Shrinkage Properties of Ceramic Clays—AMAL K. BHATTACHARYA .. .. .	115	Polyploidy in Allamanda—NIRAD K. SEN AND N. N. ROY TAPADAR .. .. .	125
The Nature of Glycine soja Agglutinins—G. W. G. BIRD .. .. .	116	Mortality of Carp Fry due to Infection by a Parasitic Ciliate—S. J. KARAMCHANDANI .. .. .	126
Methyl Ethyl Ketone Peroxide as Initiator in Vinyl Polymerization—M. R. GOPALAN AND M. SANTHAPPA .. .. .	116	A New Stage in the Evolution of the Post-Notal Plates of Insects—A. C. MATHUR .. .. .	127
Chemistry and Antibacterial Activity of Nut Grass—SENICH RADOMIR, SUKH DEV AND M. SIRSI .. .. .	118	Life-History of Shorea robusta Gaertn.—A. NAGARAJA RAO .. .. .	128
		A New Genus of Indian Itonididae:—Kittada coimbatorensis, Gen. et Sp. Nov.—R. A. AGARWAL .. .. .	129

## DIELECTRIC BEHAVIOUR OF MIXTURE OF POLAR GASES AT MICROWAVE FREQUENCIES

PREVIOUS studies in the microwave region on gaseous mixtures have dealt with absorption<sup>1</sup> and line breadth constant.<sup>2</sup> The present note reports measurements of electric susceptibility of mixture of polar gases at moderate pressures in 3 cm. region. The technique employed is similar to that reported earlier from this laboratory.<sup>3-5</sup> Mixtures of ammonia with methyl bromide were used. All the chemicals were obtained in pure form and were passed through dehydrating towers before entering the flask where gases were mixed, and sufficient time was allowed before the mixture was introduced into the waveguide cell.

The experimental results for a typical mixture (1:3 of ammonia and methyl bromide) at a series of pressures are shown in Table I. In each row are given the partial pressures (columns 2 and 4) as also the contribution to ( $\epsilon - 1$ ) from the two components (columns 3 and 5), calculated from the data obtained earlier<sup>3,6</sup> for the pure compounds and the value of their partial pressures. The sum of these two is given in column 6 and may be compared with the observed value in column 7. Thus, it will be seen that the net susceptibility of the mixture does not show any appreciable deviation from the law of partial pressures. Measurements have also been made with other ratios for the mixture (1:1 and 3:1) and also for mixtures of ammonia and ethyl chloride in

various ratios, and in all cases, the law of partial pressures was observed to hold.

The author is thankful to Shri Krishnaji for guidance and to Shri Shanker Swarup for help in the work and to Dr. Prem Swarup and Shri Y. P. Varshni for taking interest in the work.

TABLE I  
(Wavelength of radiation: 2.99 cm.;  $\text{NH}_3$  and  $\text{CH}_3\text{Br}$  mixture: 1:3)

Pressure Mixture	Partial Pressure $\text{NH}_3$	Value of $(\epsilon-1) \times 10^3$ for $\text{NH}_3$	Partial Pressure $\text{CH}_3\text{Br}$	Value of $(\epsilon-1) \times 10^3$ for $\text{CH}_3\text{Br}$	Sum of columns 3 & 4	Experimental $(\epsilon-1) \times 10^3$
1	2	3	4	5	6	7
cm.	cm.		cm.			
10	2.5	0.1	7.5	0.90	1.00	1.06
20	5	0.35	15	1.80	2.15	2.16
30	7.50	0.55	22.5	2.80	3.35	3.42
40	10	0.72	30	3.80	4.52	4.58
50	12.5	0.91	37.5	4.65	5.56	5.02
60	15	1.05	45	5.60	6.65	6.72
70	17.5	1.30	52.5	6.50	7.80	7.84
76	19	1.45	57	7.20	8.65	8.66

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### THE HEAT AND SPECIFIC HEAT OF MIXING OF $\text{He}^3$ AND $\text{He}^4$ SOLUTIONS

THE heat and specific heat of mixing of  $\text{He}^3$ - $\text{He}^4$  mixtures have been calculated by Nanda<sup>1,2</sup> using the theories of (i) Heer and Daunt, (ii) van Laar (classical regular solution model, and (iii) de Boer and Gorter. In the present note these thermodynamic functions have been computed using the asymptotic theory of liquid  $\text{He}^3$ - $\text{He}^4$  mixtures, recently published by Goldstein.<sup>3</sup> The results are compared with those of other theories.

Using the value of  $\Delta\epsilon$  given by the asymptotic theory,<sup>3</sup> the heat of mixing ( $\Delta h$ ) of a mixture of  $\text{He}^3$  and  $\text{He}^4$  in cal. per mole of  $\text{He}^3$  is given by

$$(\Delta h)_{\text{molar}} = \frac{51-X}{2X} RT^{5/3} \frac{\zeta(5/2)}{\zeta(3/2)} \times \{ (T_\lambda)^{-3/2} - (T_\lambda^0)^{-3/2} \}, \quad (1)$$

where X is the mole fraction of  $\text{He}^3$  and  $\zeta$  the Riemann zeta function. The lambda temperature of the mixture  $T_\lambda$  and the lambda temperature of the symmetric component  $\text{He}^4$ ,  $T_\lambda^0$  are related by

$$T_\lambda = T_\lambda^0 \left[ \frac{1-X}{1+X(V_3^0/V_4^0-1)} \right]^{2/3}, \quad (2)$$

$V_3^0$  and  $V_4^0$  being the atomic volumes per atom of  $\text{He}^3$  and  $\text{He}^4$ , respectively. On combining (1) and (2) it is easily seen that  $(\Delta h)_{\text{molar}}$  is independent of concentration. In Fig. 1 we have

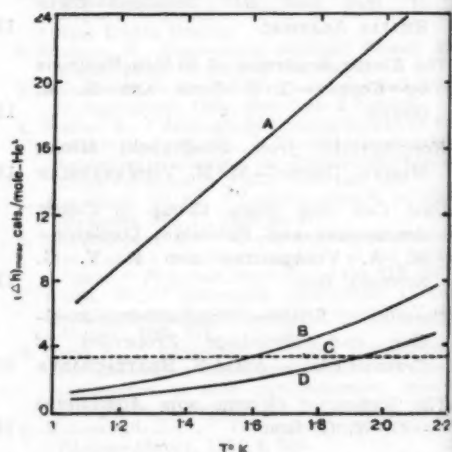


FIG. 1. The plot of calculated values of  $(\Delta h)_{\text{molar}}$ , the heat of mixing of liquid  $\text{He}^3$  in liquid  $\text{He}^4$ , for dilute solutions, against temperature.

A, de Boer and Gorter's theory (1% solution), B, Goldstein's theory, C, Van Laar's theory, D, Heer and Daunt's theory.

plotted values of  $(\Delta h)_{\text{molar}}$  for dilute solutions of  $\text{He}^3$  in  $\text{He}^4$  liquid against temperature. For comparison, values obtained from other theories<sup>1</sup> are also plotted. It will be noticed that the predicted variation of  $(\Delta h)_{\text{molar}}$  is markedly different for the different theories. Therefore, the need of experimental determination of the heat of mixing at different temperatures need hardly be emphasized to select a correct model for  $\text{He}^3$ - $\text{He}^4$  solutions. In Table I we have compared the value of  $(\Delta h)_{\text{molar}}$  according to different models with the single observation of Sommers, Keller and Dash<sup>4</sup> for a 8.6% solution at 1.02° K. The value according to the theory of Goldstein<sup>3</sup> lies closest to the observed value.

It has been pointed out by Nanda<sup>2</sup> that due to the non-availability of pure  $\text{He}^3$  in large quantities, it would be easier to collect experimental data on the specific heat of mixing. The



TABLE I

The heat of mixing for a mole of  $\text{He}^3$  for a 8.6% solution at  $1.02^\circ \text{K}$ .

Author	de Boer and Gorter	Heer and Daunt	van Laar	Goldstein	Sommers et al. Exp.
$(\Delta h)_{\text{molar}}$	3.35	0.68	3.02	1.123	1.98

expression for this thermodynamic function can be written as:

$$(\Delta C)_{\text{molar}} = \frac{25}{4} \frac{1-X}{X} RT^{3/2} \frac{\zeta(5/2)}{\zeta(3/2)} \{ (T_\lambda)^{-3/2} - (T_\lambda^0)^{-3/2} \}. \quad (3)$$

Equation (3) gives only the temperature derivative of heat of mixing and not the observed specific heat of mixing. One always measures the total heat capacity of a mixture. Therefore, the definition of Nanda<sup>2</sup> is open to criticism. This point will be discussed in detail elsewhere.

In Fig. 2 we have plotted  $(\Delta C)_{\text{molar}}$  against temperature for dilute solutions. The figure

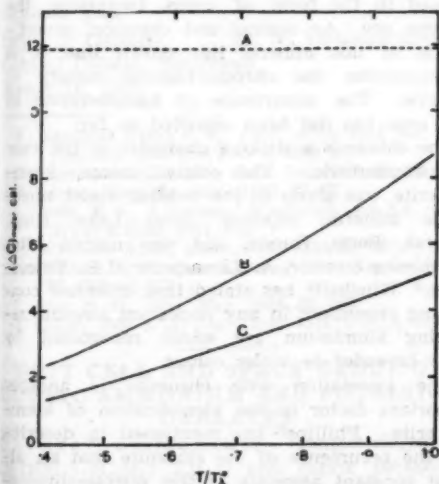


FIG. 2. The variation of  $(\Delta C)_{\text{molar}}$  with temperature for  $X \rightarrow 0$ .

A, de Boer and Gorter's theory; B, Goldstein's theory; C, Heer and Daunt's theory.

also shows the variation of  $(\Delta C)$  with temperature as predicted by the other theories.<sup>2</sup> It is found that the prediction of the theory of Goldstein is quite different from those of other theories. It is hoped that experimental determination of the specific heat of mixing will

point out the correct model for  $\text{He}^3$ - $\text{He}^4$  mixtures.

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### THE ELASTIC SCATTERING OF 90 Mev NEUTRONS BY COPPER

A CHARACTERISTIC nuclear density distribution for light elements has been obtained by Gatha, Shah and Patel<sup>1</sup> from an analysis of the experimental data on the nuclear scattering of 340 Mev protons on the basis of the first Born approximation. Subsequently, Gatha and Shah<sup>2</sup> have obtained a revised density distribution for such elements from the same experimental data by eliminating the contributions from the higher Born approximations. This revised characteristic nuclear density distribution, valid for light elements upto Al, is given by

$$\rho(\vec{r}) = a_1 \exp.(-b_1 \vec{r}^2) + a_2 \exp.(-b_2 \vec{r}^2) \times \{1 - b_3 \vec{r}^2 + b_4 \vec{r}^4\} \quad (1)$$

where

$$\begin{aligned} a_1 &= 0.12 \times 10^{30} \text{ cm.}^{-3}; \\ a_2 &= 0.25 \times 10^{30} \text{ cm.}^{-3}; \\ b_1 &= 8.62 \times 10^{26} \text{ cm.}^{-2}; \\ b_2 &= 1.09 \times 10^{26} \text{ cm.}^{-2}; \\ b_3 &= 0.44 \times 10^{26} \text{ cm.}^{-2}; \\ b_4 &= 0.13 \times 10^{32} \text{ cm.}^{-4}; \end{aligned}$$

while  $\vec{r} = r \times A^{-1/3}$  where A is the nuclear mass number. This distribution generates, in the nuclear optical model, the complex nuclear potential given by

$$V(\vec{r}) = -\hbar^2 v \bar{n} \rho(\vec{r}) \quad (2)$$

where  $\bar{n} = \bar{n}_1 + i\bar{n}_2$  determines the nuclear complex refractive index, while v is the velocity of the incident nucleon. It has been found

that with  $\bar{n}_1 = 42 \text{ mb}$  and  $\bar{n}_2 = 14 \text{ mb}$ , the experimental data on the differential scattering cross-sections  $\sigma(\theta)$  as well as the absorption cross-sections  $\sigma_a$  and the total cross-sections  $\sigma_t$  for the nuclear scattering of 90 Mev neutrons by the light elements upto Al, can be reasonably correlated on the basis of the above complex nuclear potential.

It is, therefore, interesting to investigate whether the above complex nuclear potential can



similarly correlate the experimental data on the nuclear scattering of 90 Mev neutrons by a middle element such as Cu. It has been assumed, as before, that the Glauber approximation, discussed by Gatha and Mathur,<sup>3</sup> can be reasonably used for theoretical computations. It has been found that the theoretical values of  $\sigma$ , and  $\sigma$ , turn out to be slightly higher than the corresponding experimental values given by Bratenahl *et al.*<sup>4</sup> and Cook *et al.*<sup>5</sup> respectively. The theoretical curve for  $\sigma(\theta)$ , along with the experimental values of  $\sigma(\theta)$  given by Bratenahl *et al.*<sup>4</sup> is shown in Fig. 1. It is clear

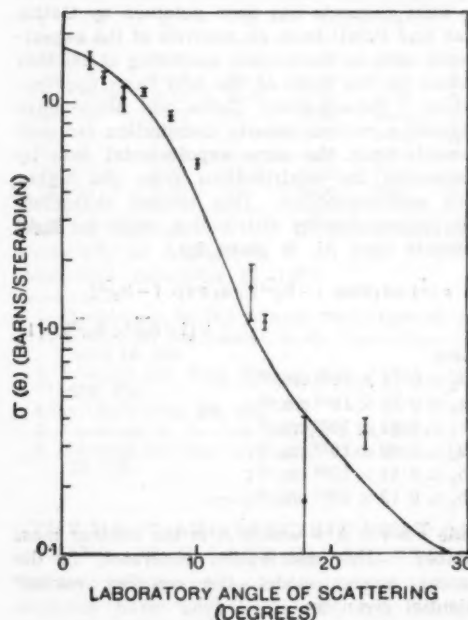


FIG. 1. Diffraction Pattern for the Nuclear Scattering of 90 Mev Neutrons by Copper.

that there is a reasonable agreement between the theoretical and the corresponding experimental values of  $\sigma(\theta)$ . Therefore, it can be concluded that the above complex nuclear potential, based upon the above characteristic nuclear density distribution, can approximately correlate the experimental data on the nuclear scattering of 90 Mev neutrons by a middle element such as Cu.

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### KÄMMERERITE FROM SINDHU-VALLI MINES, MYSORE DISTRICT

IN India, the occurrence of kämmererite has been reported from three places—from the southern borders of Mysore by Jagapathi Naidu,<sup>1</sup> from Hulikere Mines, Hassan District, Mysore, by Viswanathiah,<sup>2</sup> and from Kondapalle range of hills, Kistna District, Andhra, by Srirama Rao.<sup>3</sup> No detailed optical and chemical work on kämmererites from India are however on record.

Chromite deposits occur near Sindhuvali, Mysore District, in association with ultrabasic rocks. During the course of a recent visit to the mines, a flaky violet coloured mineral was noticed in the form of veins traversing the chrome ore. An optical and chemical investigation of this mineral has shown that it is kämmererite, the chrome-bearing variety of chlorite. The occurrence of kämmererite in this area has not been reported so far.

The colour is a striking character in the case of kämmererite. The original name, kämmererite was given to the reddish violet micaceous mineral, reported from Lake Itkul, Biserks, Perm, Russia, and was named after the mining director, A. Kaemmerer of St. Petersburg.<sup>4</sup> Winchell<sup>5</sup> has stated that chlorites containing chromium in any important amount replacing aluminium are easily recognised by their lavender or violet colour.

The association with chromite, is another important factor in the identification of kämmererite. Phillips<sup>6</sup> has mentioned in describing the occurrence of the chromite that an almost constant associate is the purple-chrome-bearing chlorite, kämmererite and that this mineral is seen as a purple film filling the interstices between the chromite. The Sindhuvali mineral is characterised both by its violet colour and its association with chromite. Under the microscope it appears as thin flakes, showing deep colours, due to high dispersion and low birefringence, surrounding the opaque chromite ore. It shows faint pleochroism with

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the following scheme: X = colourless, Y = Z = pale reddish yellow.

It is optically negative with very small optic axial angle. The refractive indices of the mineral determined by immersion method are:  $n_x = 1.585$ ,  $n_y = 1.590$ ,  $n_z = 1.590$ ,  $\gamma = 0.005$ .

The material was separated using both bromoform and Clerici's solution. The pure crop has been analysed by Sri. V. M. Raghavan, and the chemical analysis of the mineral is as follows:

SiO<sub>2</sub>, 30.07; Al<sub>2</sub>O<sub>3</sub>, 19.84; Cr<sub>2</sub>O<sub>3</sub>, 2.80; Fe<sub>2</sub>O<sub>3</sub>, 1.82; FeO, 1.98; MgO, 30.60; CaO, nil; Na<sub>2</sub>O, nil; K<sub>2</sub>O, nil; H<sub>2</sub>O, 12.76 (Total = 99.87).

The structural formula of the mineral as calculated from the atomic proportions on the basis of (O, OH) = 18 atoms, is

(Mg, Fe)<sub>0.40</sub>(Al, Cr)<sub>2.41</sub>Si<sub>2.83</sub>O<sub>8.88</sub>(OH)<sub>3.12</sub>

The chromium oxide content of 2.80% substantiates that it is kammmererite—a variety of penninite, as the percentage of Cr<sub>2</sub>O<sub>3</sub> is below 4.7

The occurrence of kammmererite near Sindhuvali, in association with the chrome ore in the form of veins, suggests a hydrothermal origin. This mode of origin for the mineral has been proposed elsewhere by Diller,<sup>8</sup> Phillips<sup>6</sup> and Srirama Rao.<sup>3</sup>

Dept. of Geology, M. N. VISWANATHIAH,  
Central College, Bangalore,  
March 16, 1956.

1. Jagapathi Naidu, P. R., *Proc. of the 30th Ind. Sci. Congress, Abstracts*, Part 3, 1943, 39.
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6. Phillips, F. C., *Quart. J. Geol. Soc. London*, 1927, 83, 639 and 647.
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8. Diller, *Bull. U.S. Geol. Surv.*, 1921, 725, A and B.

#### UNIT CELL AND SPACE GROUP OF CUPRIC AMMONIUM AND POTASSIUM OXALATES

CUPRIC ammonium oxalate-dihydrate Cu(NH<sub>4</sub>)<sub>2</sub>(C<sub>2</sub>O<sub>4</sub>)<sub>2</sub>·2H<sub>2</sub>O and cupric potassium oxalate-dihydrate CuK<sub>2</sub>(C<sub>2</sub>O<sub>4</sub>)<sub>2</sub>·2H<sub>2</sub>O are of interest because of their paramagnetic properties. They crystallise in the triclinic system and are isomorphous. Groth has given the following data for cupric ammonium oxalate:—

$$a : b : c = 0.6948 : 1 : 0.6061,$$

$$\alpha = 105^\circ 2', \beta = 104^\circ 57', \gamma = 90^\circ 18'.$$

However from its crystal habits, a different set of axes was found to be more convenient for reference.

Choosing this set of axes, regular oscillation, rotation and Weissenberg photographs were taken using CuK $\alpha$  radiation. High order reflections from the zero layer Weissenbergs taken about the three axes gave the following cell constants:—

$$a = 8.91 \text{ \AA}, \quad b = 10.65 \text{ \AA}, \quad c = 6.95 \text{ \AA},$$

$$\alpha = 122^\circ 35', \quad \beta = 83^\circ 52', \quad \gamma = 109^\circ 7'.$$

These were found to be in very good agreement with the values obtained from the rotation photographs. Using the above values the volume of the unit cell was found to be 522.28 Å<sup>3</sup>. The density as obtained by the flotation method was 1.94 gm./cm.<sup>3</sup> This gave two molecules per unit cell.

No systematic halvings were found. To determine, therefore, if the crystal belongs to P1 or P $\bar{1}$ , Wilson's statistical criterion for the existence or otherwise of a centre of symmetry was applied. Examination of the intensity distribution of the (001) projection was done in detail. The observed data were found to be very clearly consistent with the theoretical curve for the centro-symmetric case, as expected even from other grounds. The crystal thus belongs to the space group P $\bar{1}$ .

The cell dimensions of the isomorphous crystalline cupric potassium oxalate were:

$$a = 8.66 \text{ \AA}, \quad b = 10.19 \text{ \AA}, \quad c = 6.86 \text{ \AA},$$

$$\alpha = 120^\circ 41', \quad \beta = 83^\circ 52', \quad \gamma = 110^\circ 18'.$$

Complete structure analysis is under progress. Our thanks are due to Prof. R. S. Krishnan for his kind interest in the work and also Miss K. Sundaramma for loaning the crystals.  
Dept. of Physics, M. A. VISWAMITRA,  
Indian Inst. of Sci., R. V. G. SUNDARA RAO,  
Bangalore-3, February 14, 1956.

#### CORRELATION BETWEEN CONDUCTIVITY, SWELLING AND SHRINKAGE PROPERTIES OF CERAMIC CLAYS

ACCORDING to Katz<sup>1</sup> a solid swells when it takes up a liquid without losing its apparent homogeneity as its volume is enlarged and its cohesion is diminished. Katz has studied extensively the swelling of a large number of substances and he compares the behaviour of swelling substances to that of an ideal concentrated solution (Nernst.), the heat of dilution of which can be entirely changed into other forms of energy. Evidently the swelling of soils and clays is more complicated; but there is reason to believe that the orientation of molecules on the surface of clays as a result of the electrical properties of both the liquid

and the surface may follow the laws developed by Katz.<sup>1</sup> Terzaghi<sup>2</sup> has interpreted the swelling as due to the combined action of the surface tension of the water in the system and the elasticity of the solid components. Mattson<sup>3</sup> has explained the swelling of colloidal clays on the basis of the Donnan equilibrium. The investigations on the effects of the type of colloid and the nature of the exchangeable cations on swelling suggest that the concept of molecular orientation on surfaces and interfaces and around ions affords an interpretation of the process of swelling and shrinkage.

While studying the mineralogy of some Indian ceramic clays, viz., Rajmahal, Kasimbazar, Katni and Chitrakoot (obtained from the Government Pottery Works, Khurja), the conductivities of the suspensions of the above mentioned uniformly sieved clays were determined at constant temperature. Side by side the extent of the swelling and shrinkage properties of them were also carefully noted. It was interesting to observe that the swelling and shrinkage of these clays are in the same order as their conductivities.

The order of swelling and shrinkage was: Chitrakoot > Rajmahal > Kasimbazar > Katni. The corresponding specific conductances were: 2.19, 1.9, 1.66,  $0.73 \times 10^{-3}$  mho.

As the conductivity may be supposed to be due to the presence of the soluble salts, it may be argued that the swelling and shrinkage are intimately connected with the quantities of soluble salts present. This can be understood from the fact that a clay which is more chemically reactive is likely to be hydrated to a much greater degree with the result that swelling becomes more prominent. This is further supported by the fact that during the slow crystallisation of soluble salts, the clay structure is disrupted, creating what are known as 'salt boils',<sup>4</sup> which is responsible for the observed swelling. When the clay gets dried up, crystallisation of the soluble salts present in it takes place and the binding strength of the clay particles is lost and consequently shrinkage takes place. Hence the more soluble salts are present the more is the shrinkage or swelling. It is interesting to mention that observations have already been made<sup>4</sup> where the presence of soluble salts in soils imparts a damaging effect to it due to the gradual crystallisation of salts resulting into 'salt boils' and shrinkage. Therefore it may be said that the crystallisation of soluble salts is also definitely responsible for the swelling and shrinkage properties of ceramic clays.

Thanks are due to Professor A. K. Bhattacharya for his helpful suggestions and constructive criticism.

Dept. of Chemistry, AMAL K. BHATTACHARYA,  
Agra College, Agra, January 4, 1956.

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### THE NATURE OF GLYCINE SOJA AGGLUTININS

FOLLOWING the demonstration<sup>1</sup> of complete non-specific cold agglutinins in *Glycine soja*, Bird<sup>2</sup> has demonstrated that it is possible to make extracts of these seeds specific for human red cells of group B by absorbing them first with O and then A<sub>1</sub> cells. He also reported<sup>3</sup> that the cold agglutinins of *Glycine soja* were identical with the agglutinins in these seeds which reacted strongly on rabbit's cells and upon albumin suspensions of human blood cells at 37° C.<sup>3</sup> Further experiments have indicated that the B-specificity shown by these extracts after absorption with O and A<sub>1</sub> cells is exhibited only when cells suspended in saline are tested. With cells suspended in albumin the absorbed extracts are quite non-specific. The eluates obtained from various absorbing cells were also found to be non-specific when tested, even at 37° C., with both saline and albumin suspensions of human blood cells. These experiments will be completely described elsewhere along with a theory which may serve to explain the structure both of *Glycine soja* agglutinins and the similarly reacting complete non-specific cold agglutinins (auto-agglutinins) which are often present in human sera. Blood Transfusion Dept., G. W. G. BIRD,  
Armed Forces Medical College,  
Poona, March 3, 1956.

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### METHYL ETHYL KETONE PEROXIDE AS INITIATOR IN VINYL POLY- MERIZATION

METHYL ETHYL KETONE PEROXIDE (MEKP) has not been so far employed as a catalyst in vinyl polymerizations. Studies of variations of per cent. monomer conversions against time (Fig. 1 a) with MEKP at 70° C. in the case of styrene, methyl methacrylate and methyl acrylate have

indicated the nature of first order reaction, the absence of period of induction and suitability of the catalyst for further studies in the polymerization of monomers in bulk as well as in solution.

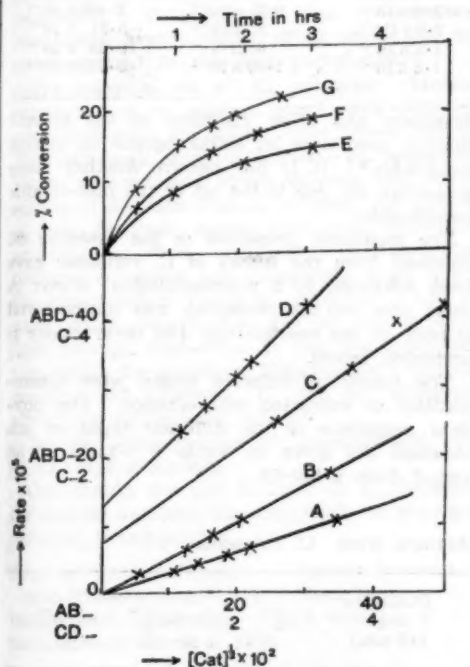


FIG. 1. (a) % Conversion *vs.* Time (hours) at 70°C. E, Methyl methacrylate ( $M = 4.6$ ) in benzene solution

- F, Styrene (bulk)  
G, Methyl methacrylate (bulk)  
(b) Rate *vs.*  $[Cat]^{1/2}$  at 70°C.  
A, Methyl methacrylate ( $M = 4.6$ ) in benzene  
B, Methyl methacrylate (bulk)  
C, Styrene (bulk)  
D, Methyl acrylate ( $M = 5.5$ ) in ethylacetate

In conformity with the behaviour of vinyl monomers polymerising under the influence of free radicals, a regular variation of overall rate ( $R$ ) with  $[Cat]^{1/2}$  (Cat—catalyst MEKP; Fig. 1 b) with various monomers ( $M$ ) in bulk and solution was observed. A linear relationship was also obtained between reciprocal degrees of polymerization ( $1/P_n$ ) and overall rates ( $R$ ) (Fig. 2 a) in bulk and at low  $[cat]$  according to the equation

$$1/P_n = (k_t R / k_p^2 [M]^2) + C_M + (C_{cat} R^2 / K^2 [M]^3) + C_s [S/M]$$

in which the third and fourth terms of right-hand side are negligible and absent respec-

tively. The constants in the above equation can be easily evaluated graphically. Utilizing the value of transfer constants for the monomers ( $C_M$ ) given by intercepts in Fig. 2 a, it was possible to plot  $(1/P_n - C_M)/R$  against  $R$  and obtain transfer constant for the catalyst  $[C_{cat}]$  and the ratio of specific rate constants for termination and propagation,  $k_t/k_p^2$ , from the slope and intercepts of the plots in Fig. 2 b. Utilizing the slopes of Fig. 1 b and intercepts of Fig. 2 b it was possible to evaluate rates of initiation ( $R_i'$ ). The results are given in Table I.

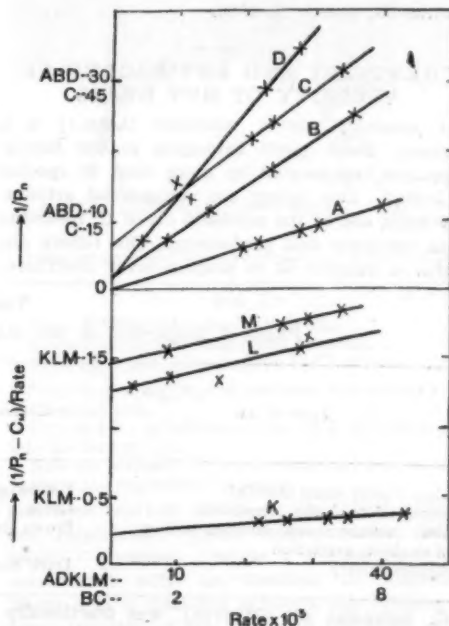


FIG. 2. (a) Rate *vs.* Reciprocal Degree of Polymerization at 70°C.

- A, Methyl acrylate ( $M = 5.5$ )  
B, Methyl methacrylate ( $M = 4.6$ )  
C, Styrene (bulk)  
D, Methyl methacrylate (bulk)  
(b)  $(1/P_n - C_M)/R$  *vs.*  $R$   
K, Methyl acrylate ( $M = 5.5$ ) at 70°C.  
L and M, Methyl methacrylate (bulk) at 65° and 70°C.

A fuller paper containing the complete results, the significance of the values of the various constants with their activation energies and the nature of decomposition of MEKP will be published elsewhere.

We thank Messrs. V. S. Vaidyanathan and V. Mahadevan of our laboratory for supplying



TABLE I

Temp. °C.	Monomer	$k_1/k_p^2$	$C_M$	$C_{cat}$	$R_i/[Cat]$
65	Methylmethacrylate	122.7	$2.0 \times 10^{-5}$	$7.46 \times 10^{-3}$	$2.083 \times 10^{-6}$
70	do	103.3	$3.0 \times 10^{-5}$	$9.2 \times 10^{-3}$	$2.440 \times 10^{-6}$
70	do. in benzene soln. ( $M = 4.6$ )	84.67	$2.0 \times 10^{-5}$	$2 \times 10^{-3}$	$5.31 \times 10^{-7}$
70	Styrene	1085	$1.2 \times 10^{-4}$	0.2174	$10.68 \times 10^{-6}$
70	Methyl acrylate	7.563	$1.8 \times 10^{-5}$	$7.69 \times 10^{-2}$	$5.733 \times 10^{-6}$

us a few results in the case of styrene and methyl acrylate.

University Physical Chem. Lab.,  
Madras-25, March 2, 1956.

M. R. GOPALAN.  
M. SANTHAPPA.

### CHEMISTRY AND ANTIBACTERIAL ACTIVITY OF NUT GRASS

NUT GRASS [*Cyperus rotundus* (Linn.)] is a common weed plant belonging to the family Cyperaceae represented by more than 60 species in India.<sup>1</sup> Dry tubers are commercial articles. The main use of the essential oil of *C. rotundus* is in medicine and perfumery. The tubers are useful in infusion or as soup in fever, diarrhoea,

dysentery and other disorders of the bowel.<sup>2</sup> Romans used it as an emmenagogue in uterine complaints.<sup>3</sup> It is not known whether these properties are due to the oil or the non-volatile constituents.<sup>4</sup>

The medicinal properties of the essential oil obtained from the tubers of *C. rotundus* have been subjected to a pharmacological study. A short note on the chemistry and antibacterial activity of the essential oil and its fractions is presented below.

The tubers of different origin were steam-distilled or extracted with alcohol. The physical properties of the different types of oils obtained are given in Table I. Yield of oil varied from 0.3-0.5%.

TABLE I

Physical properties of the oils obtained from *C. rotundus*

Type of oil	Colour	Distillation range (10 mm.)	$n_D^{21}$	$[\alpha]_D^{21}$	$d_4^{23}$
Madras variety steam distilled	.. Yellow green	112°-164°	1.5104	$\pm 0.00$	1.0101
Madras variety alcohol extraction	.. Green	110°-135°	1.5098	+1.40	0.9990
Madras variety steam distilled residue of alcoholic extraction	.. Brown green	110°-164°	1.5190	..	1.0207
Bangalore variety	.. Dark brown	..	1.4934	..	0.9533

*C. rotundus* oil (Madras) was fractionally distilled, when components with the following properties were obtained (Table II).

TABLE II

Physical properties of the fractional distillates of *C. rotundus* oil (Madras variety)

Fraction No.	Nature of the compound	B.P.	$n_D$	$[\alpha]_D^{30}$	$d_4^{30}$	% Yield
1	Hydrocarbon I (Cyperene I)	113°/10 mm.	1.509 at 30°	-16	0.9303	6 of the oil
2 A.	do. II (Cyperene II)	129°/10 mm.	1.5072 at 30°	+13.8	0.9289	14
2 B.	Hydrocarbon II was hydrogenated for one double bond and a substitution compound obtained	95°/3 mm.	1.4520 at 25°	+12	..	..
3	Alcoholic fraction (Cyperol)	148°/10 mm.	1.5105 at 26°	-16.2	..	..
4	Ketonic fraction (Cyperon)	168°/10 mm.	1.5242 at 30°	+66.4	..	..



The antibacterial activity was evaluated by the filter-paper disc method in which 8 mm. filter-paper discs are placed in an agar plate previously seeded with the test organism, 0.1 ml. of the oil put on the discs and the zone of inhibition measured after 24 and 48 hours incubation. A significant zone of inhibition maintained over a period of 72 hours was the criterion used in assessing bacteriostasis.

The essential oil of *C. rotundus* (Madras variety) and its various components obtained after fractional distillation were tested against *Staphylococcus aureus*, *E. coli*, *E. typhosum*, *Vibrio cholerae*, and *Shiga*, Schmitz and Sonne strains of *Shigella*. The oil inhibited the growth of only *Staphylococcus aureus* and was ineffective against the other organisms. Amongst the fractions, cyperone was completely inert, while the hydrocarbon fractions, cyperene I and II were more potent than the oil and cyperol. Qualitatively, they differ in that the cyperenes also inhibit the growth of *Shigella sonne*. Hydrogenation of cyperene II did not adversely affect the antibacterial activity.

Detailed pharmacological investigations will be reported elsewhere.

Our thanks are due to Prof. D. K. Banerjee for making available the compounds for pharmacological investigations.

Dept. of Organic Chem.,      SENICH RADOMIR.\*  
and Pharmacology Lab.,      SUKH DEV.  
Indian Inst. of Science,      M. SIRSI.  
Bangalore-3, March 8, 1956.

\* Present address: Belgrade Faculty of Forestry,  
Department of Chemistry, Belgrade (Yugoslavia).

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### A PRELIMINARY NOTE ON THE PHARMACOLOGY OF EVOLVINE

EVOLVINE is a liquid alkaloid from *Evolvulus alsinoides*, an indigenous plant of India (vernacular name—*Vishnuigrandhi*) (B.P. 160° C. at 0.05 mm. Hg). It was prepared by one of us (T. S. V.) and made available for pharmacological tests. With the amount available, a few preliminary pharmacological tests were carried out on dogs.

Six dogs, of varying weights (5 to 10 kilos), were used. Chloralose (100 mg./kg.) was

used as anaesthetic, a 1% solution being given intravenously. Trachea was cannulated and respiration recorded by a Marey's tambour. Blood pressure was recorded from a femoral artery. A femoral vein was cannulated for injection of drugs. The drug was administered as a 1% aqueous solution. Varying doses were tried, 0.5 mg./kg.; 1.5 mg./kg.; 2.0 mg./kg. (Fig. 1, 4) and 4.0 mg./kg. The last two doses

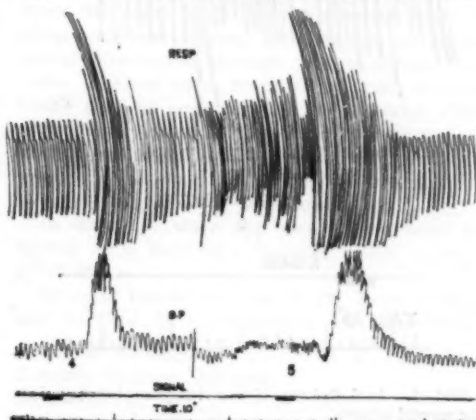


FIG. 1.

Dog. 9 Kilos, chloralose anaesthesia.  
Blood Pressure and Respiration recorded.  
Time signal and Time marking (10'') recorded.

\* At 4, 2.0 mg./kg. of evolvine was injected into the femoral vein.

At 5, 0.1 c.c. of lobeline solution (0.3 mg.) was injected into the femoral vein.

Note the similarity of time of onset and type of blood pressure and respiratory responses.

produced marked effects on the blood pressure and respiration. There was a marked rise of blood pressure while respiration was accelerated with an increase in amplitude. There was a time-lag between the intravenous administration of the drug and the onset of the effects. The interval was much shortened when the drug was given directly into one of the carotid arteries (Fig. 2, 6). With proportionate increase in dosage there was graded response. The response was not abolished by atropine (2 mg./kg.). Tetraethylammonium (T.E.A.), a potent ganglionic blocking agent, blocks the effect of the compound (Fig. 3, 8). The aqueous solution is fairly alkaline with a pH of about 9.0. Administration of solutions of sodium bicarbonate or potassium hydroxide, with the same pH, i.e., 9.0, did not produce similar effects (Fig. 3, 7). Lobeline administered similar to drug produced identical results (Fig. 1, 5).

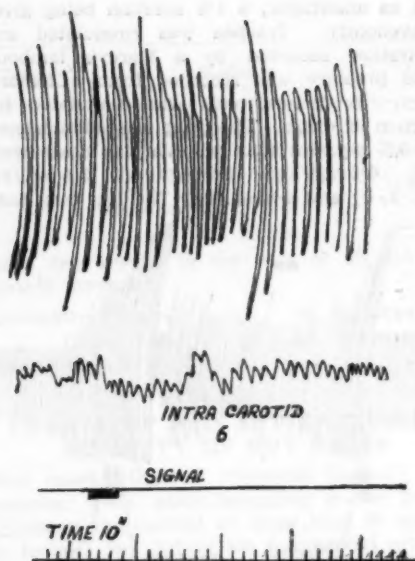


FIG. 2. At 6, 0.5 mg. of evolvine was injected into the carotid artery. Note the quicker onset.

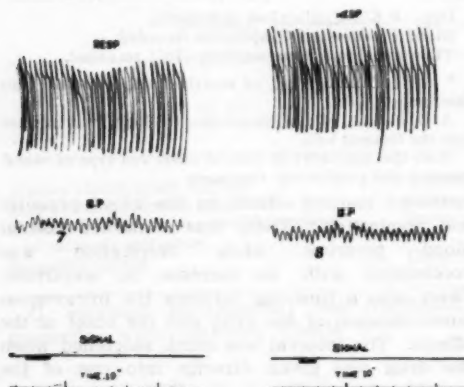


FIG. 3. At 7, 0.2 c.c. of potassium hydroxide (pH 9.0) was injected into the carotid artery.

Between 7 and 8 the animal was given T.E.A. 5 mg./kg. and an interval of 10 minutes was allowed.

At 8, 2.0 mg./kg. of evolvine, injected into the femoral vein, is seen to produce practically no effect.

The above findings show that we have a drug that probably acts on the carotid chemoreceptors similar to lobeline. The time-lag with intravenous administration and the quicker response on intracarotid administration point out the carotid chemoreceptors and/or higher

cranial centres as the probable sites of action. Stimulation of the carotid chemoreceptors by drugs like nicotine, acetylcholine or lobeline results in a rise of blood pressure and an increase in the depth and rate of respiration due to reflex stimulation of the vasomotor and respiratory centres. The fact that T.E.A. is able to block the action of the drug narrows down the site to the synaptic junction in the carotid chemoreceptors. Alkalinity of the solution is not responsible for the action, as is evidenced by the lack of response after equi-alkaline solutions of sodium bicarbonate and potassium hydroxide. Also, it has been shown that increasing the acidity of the coursing blood stimulates the carotid chemoreceptors while depression is obtained after increased alkalinity. Due to shortage of material, further experiments (such as denervation of carotid sinus nerve, etc.) to confirm the above findings, could not be performed.

Thus the drug is shown to have powerful stimulatory action on the respiration and blood pressure similar to lobeline, probably acting mainly on the carotid chemoreceptors. It will be an addition to the range of anaesthetics available now-a-days. The effect on other synaptic situations will be investigated when more of the drug is available.

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Madras, March 1956.

### SOME ABNORMALITIES IN THE VENOUS SYSTEM OF RANA TIGRINA DAUD.

SEVERAL abnormalities in the venous system of frogs have been recorded.<sup>1-6</sup> I came across the following abnormalities in the venous system of a fully grown male Indian Bull frog (Figs. 1, 2).

- (i) The right renal portal, instead of terminating in the respective kidney, continues, into persistent posterior cardinal vein upto innominate into which it opens.
- (ii) Posterior vena cava is absent in the region of kidneys although its remnant is present in the region of liver.
- (iii) There are no renal veins, but two inter-renals, from the left kidney join to form a

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single vessel, the 'united inter-renal', which connects the left kidney with the persistent posterior cardinal vein. It also receives venules from the right kidney as well as the spermatic vein from the right testis.

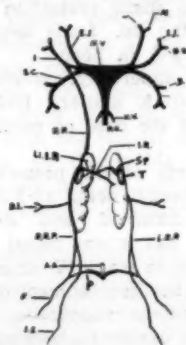


FIG. 1. A.A., Anterior abdominal vein. D.L., Dorsolumbar vein. E.J., External jugular vein. F., Femoral vein. H.V., Hepatic vein. I., Innominate vein. I.J., Internal jugular vein. I.R., Inter-renal vein. L.P.R., Left renal portal vein. M., Mandibular vein. M.C., Musculo-cutaneous vein. P., Pelvic vein. P.C., Posterior caval vein. R.P., Right posterior cardinal vein. R.P.P., Right renal portal vein. S.C., Subclavian vein. S.S., Subscapular vein. S.V., Sinus venosus. I., Ischiadic vein. U.I.R., United inter-renal vein. Sp., Spermatic vein. T., Testis.

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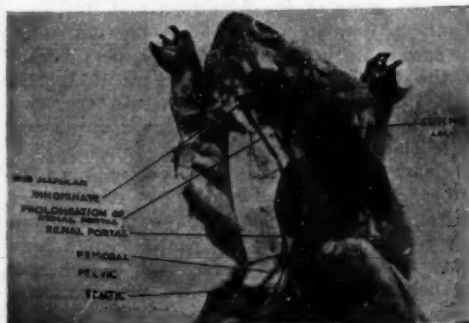


FIG. 2

From the above, it appears that during metamorphosis, the posterior portions of the right and left posterior cardinal veins, which serve as principal collecting vessels from the hinder region of the body of tadpole, failed to fuse in a single median vena cava. Further, the left posterior cardinal vein disappeared while right one has persisted. Probably this accounts for the absence of posterior vena cava in the region of kidneys.

Due to the normal arrangement of the veins on the left side, the blood from the left hind

limb is brought to the left kidney; from there it reaches to the persistent cardinal vein through united inter-renal and finally into innominate. The venous blood from the right side goes to the right kidney through the right renal portal and a part of which capillarises in it; the blood is then collected by another set of capillaries into the united inter-renal. It is, therefore, quite likely that a part of blood from the right hind limb is directly taken to sinus venosus without undergoing any renal portal circulation through the persistent posterior cardinal vein. Some blood from the hind limbs goes to liver through the anterior abdominal vein, which is present in this frog as in normal condition. The blood from the liver goes to sinus venosus through the anterior portion of the posterior vena cava.

In order to trace the veins, they were injected with Ranvier's Purssian Blue gelatine solution.<sup>7</sup>

Grateful thanks are due to Dr. Daya Krishna and to Prof. B. C. Mahendra for suggestions.

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Jaswant College, Jodhpur,  
December 7, 1955.

S. C. SHARMA.

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### OCCURRENCE OF *JOHNIUS HOLOLEPIDOTUS* (LACÉPÈDE) IN INDIAN WATERS\*

WHILE slight changes have been introduced in the nomenclature of Indian Sciaenids by Fowler<sup>1,2</sup> and Weber and Beaufort,<sup>3</sup> no species essentially different or additional to those described by Day<sup>4,5</sup> have so far been recorded from Indian waters. It was interesting to find therefore some specimens of *Ghols* among the catches of the Government of India trawlers in February 1955, which were distinct from all the species described by Day<sup>4,5</sup> for Indian waters as well as by Weber and Beaufort<sup>3</sup> for the Indo-Australian archipelago. They were also different from other *Ghols* usually occurring in Bombay markets and in the trawler

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catches by their more elongate form, smaller eyes, truncate to double-emarginate caudal fin, a dark axillary blotch and, in fresh specimens, a row of shining spots along the lateral line on either side of the body. Detailed examination has brought the above *Ghols* into the species described as *Johnius hololepidotus* (Lacépède) by Fowler<sup>2</sup> and Smith.<sup>6</sup> The following are the diagnostic characters of the Indian examples based mainly on a single specimen which is at the Central Marine Fisheries Research Station. A photograph of the specimen is given in Fig. 1.

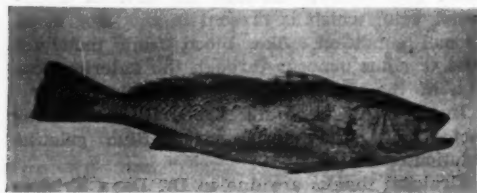


FIG. 1. Photograph of Indian specimen of *Johnius hololepidotus* Lacépède—right view.

**Description.**—B. VII; D.X., 1, 27; A.II, 7; P.18; V.I, 5; C.18. Head about 4 in standard length; depth  $4\frac{1}{4}$ ; snout a little over 3 in head; eye 7 or even a little more in head; 2 in snout and a little over 2 in interorbital distance; interorbital convex. Lower jaw slightly longer than upper; six pores below mandibular symphysis. No mandibular barbel. Posterior end of maxilla reaches to below hind edge of eye. Snout has no lateral lobes. No palatine teeth. In lower jaw, teeth in two series, outer villiform and inner enlarged and conical. In upper jaw three front teeth on each side large and widely separated. Operculum with two blunt, spine-like processes; pre-opercle entire.

**Fins.**—5th dorsal spine the longest, about 3 in head, 4th and 3rd next in order; 2nd anal spine 5 in head and about  $\frac{1}{3}$  shorter than the 1st ray. Anal commences opposite about 12th dorsal ray; base 5 in soft dorsal.

**Scales.**—On body feebly ctenoid, continued on the caudal fin but not on the soft dorsal and ventral. Tubular scales 56 upto base of caudal fin and some more (not easily countable) on caudal fin. Immediately above lateral line there are about 25 special scales interspersed with others and appear in fresh specimens as a row of silvery spots along the sides of the body. These scales are slightly larger than the others and stand out prominently in the wet specimens on account of their silvery sheen. Nine scales between lateral line and

spinous dorsal; 17 between lateral line and base of ventral; 21 between lateral line and ventral middle line.

**Caudal** may be described as truncate to double-emarginate, the truncate nature being interrupted by a slight projection of the middle portion of the fin. Least depth of caudal peduncle about  $3\frac{1}{2}$  in head.

**Colour.**—Grey superiorly; whitish grey below. A large dark axillary blotch, i.e., the fleshy process at the base of pectoral fin large and dark.

The total length of the preserved specimen is 104 cm., the caudal being 10.5 cm. Ten individuals were dissected and examined for gonad condition and it was found that some of the females were in stage IV of maturity.

Fowler<sup>2</sup> gives the geographical distribution of *Johnius hololepidotus* (Lacépède) as follows: Eastern Tropical Atlantic, Mediterranean, Red Sea, Madagascar, Natal, South Africa, Western Australia, South Australia, Victoria, Tasmania, New South Wales and Queensland.

In the above instance of the occurrence of the species in the Saurashtra waters of India as many as 57 specimens (all full grown adults) were reported to have been caught in a single haul during bull-trawling near Porbunder, at a depth of 22-26 fathoms. The specimens were considered as 'unusual' and 'new' by some of the fishermen and fish merchants in Bombay. The author did not notice the species in the earlier and subsequent catches of the trawlers (during the years 1953, 1954 and 1955) but Shri K. H. Mohamed (personal communication) has noticed specimens somewhat similar on some previous occasions. It is clear, however, that the species must be rather rare in Indian waters, if it is not a migrant from the Red Sea or the African Coast where it is said to form a good fishery.

My thanks are due to Shri K. H. Mohamed for help in taking the detailed measurements.

Offshore Fisheries

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January 14, 1956.

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# **B-CHROMOSOMES IN *PANICUM* *COLORATUM***

THE presence in germ cells of certain chromosomes in excess of the normal complement found in root tips has been recorded in several plants like maize, rye, *Sorghum*, *Poa*, etc. These chromosomes are in many cases smaller than the regular chromosomes, may be heterochromatic and may pair among themselves when two or more of them are present. They seldom pair with the regular chromosomes and usually have no discernible effects on plant characters except that an accumulation of them leads to a reduction in pollen- and seed-fer-

red to as 'B' or accessory or supernumerary chromosomes to distinguish them from the 'A' or primary chromosomes (see review by Müntzing<sup>1</sup>). In the present report, the behaviour of B-chromosomes in plants of *Panicum coloratum* L., identified during the course of our cytological studies in the tribe *Paniceae* of *Gramineae*, is described.

*Panicum coloratum* is a native of Africa and is a good fodder grass. Meiosis was studied in five plants during microsporogenesis in preparations made by the propino-carmin technique (Swaminathan *et al.*<sup>2</sup>) and in Feulgen squashes. At diakinesis and metaphase I, 18

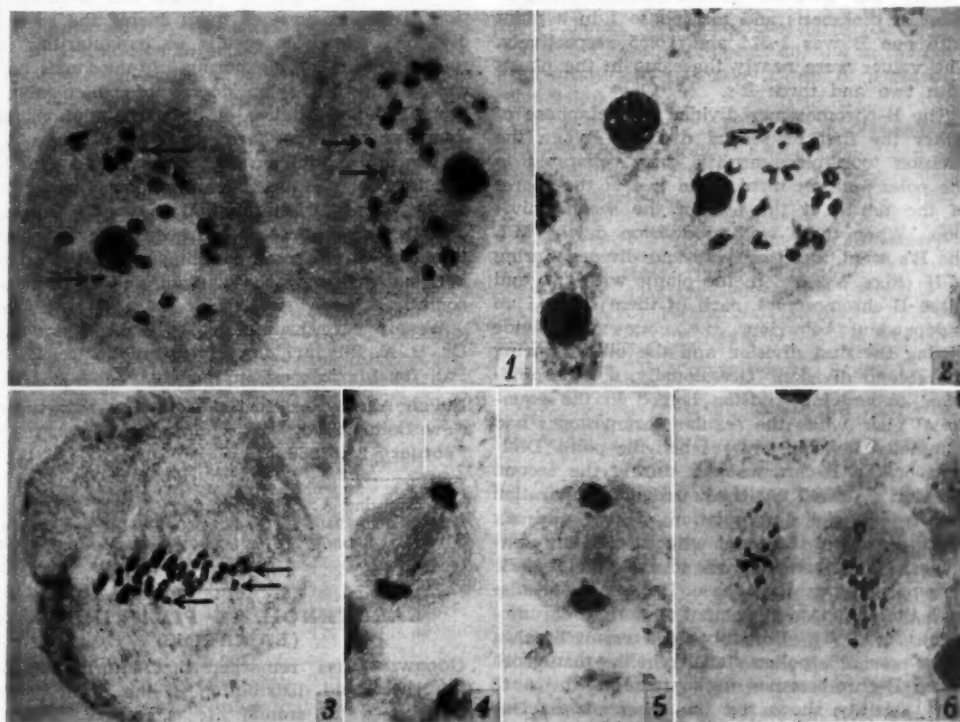


FIG. 1. Diakinesis, 18 bivalents and 2 B-chromosomes.

FIGS. 2 and 3. Diakinesis and Metaphase I respectively in a plant with 3 B-chromosomes.

FIG. 4. Late Anaphase I. An undivided B-chromosome is going to one pole.

FIG. 5. Regular separation of a B-chromosome which has divided during the first division.

FIG. 6. Irregular separation of chromosomes at Anaphase II resulting from the presence of several B's. Arrows indicate B-chromosomes (Magnification of Microphotographs, x 750).

tility and plant vigour. The most striking feature of such chromosomes is their persistence in germ cells and absence in root tips. In view of these distinct characteristics and their uncertain genetic role, they are commonly refer-

bivalents were observed. Besides these, there was one accessory chromosome in three plants; there were two in one plant and there were three in another (Figs. 1-3). All the pollen mother cells examined contained these



chromosomes which were stained in the same way as the normal chromosomes. They were Feulgen-positive. The number of B-chromosomes was usually constant in the different pollen mother cells of a plant; in the plant with two B-chromosomes, however, only one could be identified in some cells. The pairing of the regular complement was in no way affected by the presence of the B-chromosomes. The B's themselves did not show pairing both at diakinesis and metaphase I in any of the 100 cells examined in each plant. They were also never found to be attached to the normal chromosomes. The mean chiasma frequency per bivalent of the regular complement at diakinesis and metaphase I in a plant with one B was 1.874 and 1.855 respectively. The values were nearly the same in the plants with two and three B's.

The B-chromosomes divided at metaphase of either the first or second division. When the division took place at M I, they separated to the poles and got included in two of the spores of the tetrad at the end of the second division. When there was no division during M I, the B's went to either pole and divided during M II (Figs. 4 & 5). In the plants with two and three B-chromosomes, each of them showed an independent behaviour, i.e., one may divide during the first division and the others during the second division. Occasionally, a B-chromosome undergoing division lagged in the equatorial plate while the regular chromosomes had completed division and reached the poles. Division of the B-chromosomes during the second division followed by their irregular separation resulted in the accumulation of five and six B's in spores of the plant with three B-chromosomes. The presence of several divided B-chromosomes at metaphase II seemed to disturb the anaphase movement of normal chromosomes (Fig. 6). Probably as a result of this, there was 20% pollen sterility in the plant with three B-chromosomes in contrast to the 5 to 10% sterility shown by the other plants. Due to extensive seed-shedding in these plants, critical data on seed fertility could not be gathered.

The B-chromosomes could also be seen in the pollen. In most cells, they divided and went to the opposite poles during the first pollen mitosis; in a few cases the divided B's were found to proceed to the same pole. Pollen transmission of the B-chromosomes is thus possible.

Seeds from the *P. coloratum* plants were germinated and the somatic chromosomes were studied in orcein and feulgen squashes made from the tips of primary roots. No B-chromosomes have so far been observed in the root tip cells. Attempts are being made to find out whether these chromosomes are present in shoots and young leaves.

To summarise, the B-chromosomes in *P. coloratum* are absent in root tips, do not pair but undergo a mitotic division during meiosis, divide during pollen mitosis and are not heterochromatic. Their presence causes no visible changes either in the morphological characters or vigour of plants but accumulation of five or more of them during the second division of meiosis results in irregularities in the separation of the normal chromosomes and consequently in some degree of pollen abortion. Detailed studies on large populations of *Panicum coloratum* are now in progress to gather information on the adaptive and genetic significance of the B-chromosomes and the causes for their elimination in roots. Colchicine treatment of seeds has been done to ascertain how chromosome doubling affects the number and pairing behaviour of the B-chromosomes.

We are very grateful to Dr. S. M. Sikka and Dr. P. N. Bhaduri, for advice and to Dr. B. P. Pal, for his interest in the study.

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#### CAROTENOID IN *PILA VIRENS* (LAMARCK)

GOODWIN<sup>1</sup> has remarked that information on the carotenoid distribution of the lower forms of fresh-water animal life is meagre. This is particularly the case with the molluscs. While the carotenoid distribution of a fairly good number of marine molluscs has been studied, our knowledge of the fresh-water molluscs is limited only to a few forms like *Planorbis corneus*, *Limnaea stagnalis* and the New World species of the apple snail, *Pila canaliculata*. Comfort<sup>4</sup> investigated the last of these species and reported the occurrence of carotenoids in the eggs and the liver of the new-born larvae

and adults. The eggs of this species are pigmented and laid out of water. Species of *Pila* whose eggs are laid in burrows and are unpigmented are found in India, and Goodwin<sup>2</sup> has pointed out that it would be interesting to know whether these forms are completely devoid of carotenoids. The present note deals with the carotenoids of the South Indian species of the apple snail, *Pila virens* (Lamarck).

The digestive gland (liver), uterus and testis were studied for the presence of carotenoids. For the extraction of the pigment the method given by Nicola and Goodwin<sup>5</sup> and for saponification the method given by Goodwin and Srisukh<sup>6</sup> were followed. The pigments were separated by the chromatographic method using alumina as adsorbent and light petroleum with varying amount of ether as developer. The identification of pigments was done by the study of their absorption spectrum and the quantitative estimation by the colorimetric method using a photo-electric colorimeter.  $\beta$ -Carotene is practically the only carotenoid present in *Pila virens*, only a trace of  $\alpha$ -carotene being present. There is no trace of xanthophylls.

The quantitative distribution of carotene in the digestive gland, testis and uterus was studied in the normally active animal and also during the breeding season and hibernation. Table I summarises the result.

TABLE I

Organ	Amount in $\mu\text{g./g. wt.}^*$		
	Normal	Breeding season	Hibernating (6 months)
Digestive gland	734	590	615
Testis	65	250	65
Uterus	50	175	44

\* Mean value for five experiments.

It is seen from the table that normally there is a good amount of carotene in the digestive gland of the animal which, however, decreases during the breeding season. The testis and uterus, on the other hand, normally contain only a negligible amount of carotene, but which shows considerable increase during the breeding season. This suggests a mobilisation of the pigment.

From controlled feeding experiments carried out, the source of carotene could be traced to the food of the animal, consisting of aquatic plants like *Vallisneria* with large amount of

chlorophyll, xanthophyll and carotenes. As shown in a previous investigation,<sup>7</sup> the digestive gland is the sole site of absorption of digested food in the animal, and as carotene is the only carotenoid pigment present in this organ, it is evident that carotene is selectively absorbed from the food. This is confirmed by the fact that the extract of the digestive gland has a certain amount of destructive effect on xanthophylls and not on carotenes. Generally in the molluscs, as Goodwin<sup>3</sup> has pointed out, xanthophylls predominate and in *Mytilus xanthophylls* are selectively absorbed as shown by Scheer.<sup>8</sup>

My thanks are due to Prof. R. V. Seshaiya for guidance, to Dr. Venkateswarlu for help in taking the absorption spectrum, and to the Government of India for the award of a research scholarship.

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Annamalainagar,  
January 23, 1956.

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### POLYPLOIDY IN ALLAMANDA

SEVERAL species of the genus *Allamanda* have been introduced into the gardens for their extreme beauty. Their shining green foliage, large golden yellow or purple flowers and the ease with which these climbing shrubs can be trained on trellis or trimmed to desired size are their special attractions. The plants do not set seed, though occasionally spiny globular fruits are seen in some plants, but it is reported that some species were introduced through seeds. They can, however, be easily propagated by cuttings or grafted.

The commonly grown species are *A. violacea*, *A. nerifolia*, *A. cathartica*, *A. grandiflora*, *A. nobilis*, *A. schottii*, *A. magnifica* and *A. williamsii*. According to Bailey,<sup>1</sup> with the exception of *A. violacea* and *A. nerifolia*, all the other species found in the gardens are probably varieties of *A. cathartica* Linn.

Chromosome numbers have been reported for two species of *Allamanda* which according to

Bailey<sup>1</sup> are varieties of *A. cathartica*. Darlington and Ammal<sup>2</sup> have quoted  $2n = 18$  chromosomes for *A. williamsii* observed by Sugiura,<sup>3</sup> while Pathak *et al.*<sup>3</sup> observed the same number of chromosomes  $n = 9$  in *A. grandiflora* Hook.

Among the two horticultural types in our nursery, *A. violacea* is so conspicuously different from the other type, *A. cathartica* var. *nobilis* syn. *A. nobilis* T. Moore, that it was thought desirable to study whether there is any cytological basis for their differences. *A. violacea* is readily distinguished from the *A. cathartica* varieties for their thicker leaves and wine purple-coloured flowers, the *A. cathartica* flowers being golden yellow. Among the other differences rough surface of stem and leaves due to the presence of hairs, subpetiolate and elliptical fleshy leaves and slightly larger pollen may be mentioned.

Cytological studies of the two types of *Allamanda* have revealed that the conspicuous difference of *A. violacea* from the other type is associated with doubled chromosome number in its complement. In *A. cathartica* var. *nobilis* studied, the chromosome number is  $n = 9$  and  $2n = 18$ , similar to the number reported by Sugiura<sup>4</sup> and Pathak *et al.*<sup>3</sup> for the two horticultural species of *Allamanda*, while in *A. violacea* the chromosome number is  $2n = 36$ .

Mitotic chromosomes were studied in well spread metaphase plates from aceto-orcin squash of root tips. Root tips of stem cuttings were treated in 0.2% coumarin solution for  $2\frac{1}{2}$  hr., heated in 9 parts of 2% aceto-orcin and 1 part of NHCl and finally squashed in 1% aceto-orcin. Eighteen chromosomes in *A. cathartica* (Fig. 1) ranged from  $1.8-3.6\mu$  in length and had median or sub-median constriction. A pair of satellited chromosomes could easily be distinguished. In *A. violacea* (Fig. 3) 36 chromosomes are seen with two pairs of satellited chromosomes. The size of chromosomes ranged from  $1.8-3.8\mu$  in length.

Meiotic chromosomes were studied in pollen mother cells fixing the flower-buds in acetic alcohol (1:3), mordanting in 4% iron alum for 10 min., smearing in aceto-carmin, and finally removing the cytoplasmic stain by running 45% acetic acid inside the coverslip, warming and pressing both at the time of staining and destaining. Nine well spread bivalents are seen at the meiotic metaphase of *A. cathartica* (Fig. 2). In *A. violacea* though bivalents and quadrivalents are most common, all types of configurations from univalents to hexavalents are seen (Fig. 4). In the 10 metaphase plates examined the mean frequency of I-VI

configurations were 1.0, 6.6, 0.6, 4.0, 0.2 and 0.5 respectively, per cell.



FIGS. 1-4.

Mitotic and Meiotic Metaphase Plates of *Allamanda cathartica* var. *nobilis* (Figs. 1 and 2) and *A. violacea* (Figs. 3 and 4),  $\times 1,000$ .

From the number of chromosomes and meiotic configurations, it may be concluded that *A. violacea* is a polyploid type in *Allamanda*. It should be considered as a distinct species from the races of *A. cathartica* like var. *grandiflora*, var. *williamsii* and var. *nobilis*, the common horticultural species of *Allamanda*, for its conspicuous morphological differences in vegetative and reproductive parts and having double the number of chromosomes.

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#### MORTALITY OF CARP FRY DUE TO INFECTION BY A PARASITIC CILIATE\*

DURING the course of certain riverine investigations on the availability of fish seed of major carps in the river Ganga at Dighwara (Bihar) in the period June-July 1952, a case of mortality of carp fry, was observed in appreciable

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numbers, while rearing carp fry in glass jars in the field laboratory, due to the infection by a parasitic ciliate, *Trichodina* sp.

On 24-6-1952, a sample of one hundred carp fry from the collections, obtained from the river Ganga, was kept in a clean glass jar ( $4\frac{1}{2}'' \times 4'' \times 8''$ ) containing 1.25 litres of river-water and were fed on plankton, collected from a nearby nursery tank. On the following day, six carp fry were found dead which was attributed to the injury and shock, incident to collection and segregation. On 26-6-1952, however, there was heavy mortality of carp fry (55.3%) in the same jar which was considered unusual, since the carp fry normally recover from the shock of collection, etc., within 24 hours. Microscopic examination of living and dead carp fry revealed that they were heavily infected with *Trichodina* sp. The entire sample was then examined and the number of ciliate parasites, harbouring in the various parts of each living individual, was counted. Out of 42 living carp fry 33 were found infected. The infected fry were preserved in 2% formalin for further study.

Fry measuring 6-7 mm. were infected 100% and harboured 30-50 parasites each on the body, specially on and near the fins. The infection in fry measuring 8-9 mm. was 65% and 77.8% respectively and they harboured 25-40 parasites. Microscopic examination of the dying (14 specimens) and dead fry (18 specimens) showed that the number of ciliates was far more (average number of parasites, 44) on the former than on the latter (average number of parasites, 21) suggesting that in all probability the ciliates abandon the host soon after death. The fry reared in the jar were emaciated and sluggish in their movement, in spite of the fact that they were regularly fed on live zoo-plankton.

A similar case of mortality of carp fry due to the infection of *Trichodina* sp. was also observed by the author at Nimtita (W. Bengal) on 4-8-1949, when carp fry were kept in an enamel tray for 2-3 days. The percentage of mortality in this case could not be determined as there was no record of initial number of carp fry in the tray.

This protozoan is capable of free living in the plankton also and the infection might have taken place either from the river-water or from the pond-water from where the plankton was collected. The parasites increased in large numbers in the jar and thus were responsible for the mortality. It is also seen that the rate of binary fission of *Trichodina* sp. is more

during the monsoon period than in other seasons of the year.

Tripathi<sup>4,5</sup> and Lagler<sup>2</sup> state that some species of *Trichodina* may cause epidemic mortality in fresh-water fish hatcheries and nursery ponds. The mortality of fresh-water fry due to other parasitic infection is also not uncommon in the hatcheries (Flakes,<sup>1</sup> Seaman,<sup>3</sup> Wagner and Perkins<sup>6</sup>). The poor yield of carp fry from nurseries, very often reported in India, could be partly due to mortality caused by parasitic infection.

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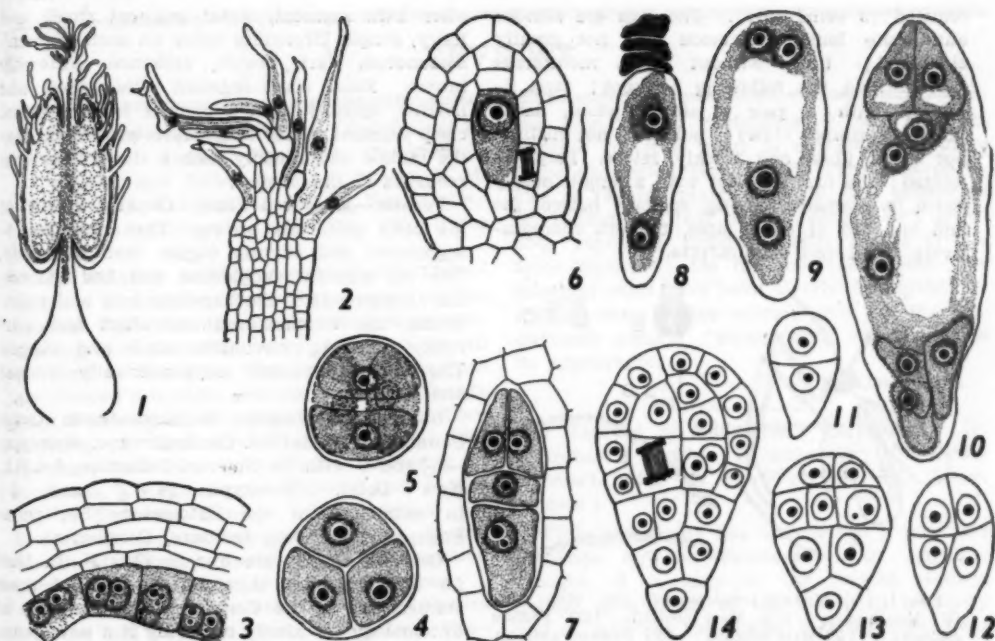
#### A NEW STAGE IN THE EVOLUTION OF THE POST-NOTAL PLATES OF INSECTS

SNODGRASS<sup>1</sup> has explained the possible evolution of the post-notal plates from the intersegmental membranes. The intersegmental membrane, in most of the arthropods has become chitinized secondarily, as a result of which the primitive intersegmental fold becomes the sub-marginal ridge, the *antecosta*, while its corresponding external groove becomes the *antecostal suture*. From the anterior wall of the *antecosta* has developed a narrow flange, the *acrotergite*. In the case of the tergum, the *acrotergite* together with the *antecosta* and the *antecostal suture* has fused secondarily with the tergum of the following segment. The *acrotergite* in the mesotergum has remained a narrow flange, but the *acrotergite* in the metatergum and the *acrotergite* in the first abdominal tergum have enlarged and extended forward up to the posterior margin of the preceding tergum, thus reducing the intersegmental membranes. As these *acrotergites* have reduced the intersegmental membranes between the mesonotum and the metanotum, and between the latter and the first abdominal tergum, these *acrotergites* form the post-notal plates. Though these post-notal plates have fused secondarily with the terga of the following segments, they belong morphologically to the tergal plates of the preceding segments.









FIGS. 1-14. *Shorea robusta*. Fig. 1. Stamen, note the hairs on the prolonged connective,  $\times 25$ . Fig. 2. Tip of the connective enlarged,  $\times 100$ . Fig. 3. T.S. of anther wall,  $\times 500$ . Figs. 4-5. Tetrahedral and decussate tetrads,  $\times 1,500$ . Fig. 6. Megaspore mother cell and two parietal cells,  $\times 500$ . Fig. 7. T-shaped tetrad,  $\times 750$ . Figs. 8, 9. Two and four nucleate embryo sacs,  $\times 750$ . Fig. 10. Mature embryo sac,  $\times 750$ . Figs. 11-14. Stages in the development of the embryo,  $\times 500$ .

The fertilized egg undergoes a very belated transverse division resulting in a two-celled embryo (Fig. 11). Vertical walls are laid down in both these cells and a globular tetrad is formed (Fig. 12). Further divisions follow the same pattern as in *Shorea talura* and a mature embryo is formed. The mature dicotyledonous embryo has a prominent radicle and two fleshy unequal cotyledons, one enclosing the other. Seed-coat is formed by both the integuments. The one-seeded indehiscent fruit is enveloped by the accrescent sepals, which develop into wings.

I am thankful to Prof. K. N. Narayan for kind encouragement and interest, and to Dr. K. Subramanyam, for helpful suggestions. I am indebted to the authorities of the Mysore University for the award of a research fellowship.

Dept. of Botany,  
Central College,  
Bangalore-1, March 18, 1956.

A. NAGARAJA RAO.

# A NEW GENUS OF INDIAN ITONIDI- DAE:—*KITTADA COIMBATORENSIS*, GEN. ET SP. NOV.

RAO<sup>1</sup> has reported about 121 genera under Oriental Itonididae, as occurring in India. The broad characters of the family are: minute delicate flies with long antennae adorned with conspicuous whorls of hair; wings with few longitudinal veins; coxae not elongate; tibiae devoid of spurs. A new genus *Kattada* reported below was found on *spontaneum* rust (*Puccinia kuehnii*). This new Diptera has been named as *Kittada coimbatorensis* (gen et sp. nov.) from the Sanskrit word *Kitta*=rust, *ada*=eating and *coimbatorensis* since it was collected, for the first time, from Coimbatore. The description of the same is as follows: Family—Itonididae, Subfamily—Itonididinae, Tribe—Itonididinae, Subtribe—Trifila.

*Kittada coimbatorensis* gen. et sp. nov. is a minute insect with an extremely delicate and fragile structure. Wing expanse 2.4-3.4 mm. The body is clothed with hairs. The antennae are long and adorned with conspicuous whorls of simple circumfila. Eyes confluent above and ocelli are wanting. Wings big and broader, spotted by small hair, wing-veins greatly

1. Gamble, J. S., *The Flora of the Presidency of Madras*, 1925, London.
2. Nagaraja Rao, A., *Phytomorphology*, 1953, 3, 476.
3. —, *Mys. Univ. J.*, 1955, 15, 519.
4. —, *Proc. Nat. Inst. Sci. India*, in press.

reduced (3 veins only). The legs are slender and quite long, the coxae are not greatly elongated; tibiae without spurs, metatarsus shorter than the following segment; tarsi 5-jointed with a pair of simple, stout, dark-brownish simple claws; pulvillus not distinct but distal tibial end thickly setose. Palpi 4-jointed; the first segment with a length nearly twice its diameter, oblong, sparsely haired, the 2nd and 3rd of equal sizes, the 4th comparatively small and subquadrate.

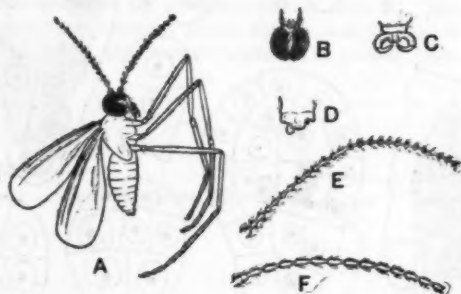


FIG. 1. (A) *Kittada coimbatorensis*, gen. et sp. nov.; (B) Mouth parts; (C) Male genitalia; (D) Female genitalia; (E) Male antenna; (F) Female antenna.

**Male.**—Length 0.9 mm. Antennae about  $1\frac{1}{2}$  times longer than the body, the first segment subglobose and second globose, 26-segmented, flagellate greatly produced and alternately binodose, global joints of the flagellate shortens

after 14th segment, distal segment small and hairy, simple circumfila occur on each segment. Mesonotum dark brown, abdomen uniformly brown. Basal clasp segment rather short and narrow, apically with a distinct lobe, terminal clasp segment rather long, scarcely swollen near the middle and apically with a stout, somewhat recurved chitinous spur.

**Female.**—Length 1.2 mm. General colour of the body uniformly brown. The antennae 15-segmented and slightly bigger than the body. The 1st segment subglobose and 2nd globose, the 12 segments of the flagellate long and cylindrical, the terminal segment short and narrowly pointed; circumfila small and simple. The ovipositor small, asymmetrically bilobed and distinct.

**Habit.**—Mycophagous; **Habitat.**—South India, Coimbatore, 7-11-1955. On Sugarcane; **Holotype.**—♂ and ♀ with the National Collection, I.A.R.I., New Delhi. Paratype (4—♂ and ♀) in collections of the Entomology Section at Sugarcane Breeding Institute, Coimbatore.

Grateful thanks are due to Shri N. L. Dutt for encouragement during the course of these studies, and to the Commonwealth Institute of Entomology for kindly declaring it a new genus and new species.

Sugarcane Breeding Inst., R. A. AGARWAL.  
Coimbatore, March 2, 1956.

1. Rao, S. N., *J. Res. Agr. Univ.*, 1955, 4, 213.

## RELEASE OF ENERGY FROM THE ATMOSPHERE AT HIGH ALTITUDES

SCIENTISTS at the Holloman Air Development Centre in New Mexico have found that nitric oxide has the property of bringing two oxygen atoms together to form an oxygen molecule and release the energy from sunlight which has been "chemically stored" in atomic oxygen high up in the earth's atmosphere. To test the laboratory discovery, a rocket was fired 60 miles up into the atmosphere where it released nitric oxide gas under high pressure. A flood of light resulted. In fewer than ten minutes the light had grown in size so that it appeared from the earth to be about four times the moon's diameter. The spot of light spread to about 3 miles in width before the gas thinned out and the brightness dimmed.

Several suggestions have been made about chemical reactions in which nitric oxide, present naturally in the upper atmosphere, might take part. One of these is the interaction with oxygen atoms mentioned above. A cyclic series of reactions has been proposed, in which the nitric oxide is regenerated. In that way the presence of a comparatively small quantity of nitric oxide could lead to a continuous emission of light and it is believed that further experiments on these lines may lead to a means of extracting this stored energy for such uses as the propulsion of rocket ships high in the atmosphere.

## REVIEWS

**High Energy Nuclear Physics. (Proceedings of the Fifth Annual Rochester Conference.)** Compiled and Edited by H. P. Noyes, E. M. Hainer, G. Yekutieli and B. J. Raz. (Interscience Publishers), 1955. Pp. 197. Price \$2.50.

The situation in high energy physics undergoes a thorough and critical survey at the Annual Rochester Conferences and their proceedings are therefore eagerly awaited by all workers in this field. The present proceedings are divided into eight sessions: (1) Low Energy Pion Phenomena; (2) High Energy Pion Phenomena; (3) Theoretical Physics; (4 & 5) Elementary Particles; (6) Elastic Scattering of Nucleons; (7) Accelerator Physics; and, finally, (8) A Summary Session. Most sessions are introduced by brief surveys. In view of the wealth of material discussed, one can mention only a few of the important presentations.

One of the main advances in meson physics was the first clear evidence, coming from Coulomb interference at small angles, that the signs of the pion-nucleon phase-shifts were what one had always supposed them to be, and that therefore the major interaction in the  $3/2-3/2$  state was attractive. The discrepancies in the low energy behaviour of the S-wave phase-shifts arising from different experiments were discussed, and Bethe suggested a remeasurement of all the experimental numbers involved.

Chew and Low presented the results of some investigations on pion-nucleon scattering and photo-meson production, based on a new and promising approach due to Low. Low sets up the scattering problem in terms of the wave-functions of the physical particles rather than those of the "Bare" particles, as is done in the Tamm-Dancoff method. Though the resulting integral equation has again to be cut off after the one-meson term, this seems to be an improvement over the corresponding Tamm-Dancoff approximation.

Williams has analysed cosmic-ray data to get a nucleon-nucleon total cross-section of  $\sim 120$  mb at high energies ( $\sim 30$  Bev). This is much larger than "geometric".

No new decay modes of the heavy unstable particles were reported but more instances of known modes, with better determinations of Q-values, masses and life-times, were presented. It is interesting to note, however, that at

the time of the conference, it was still not possible (as it is now) to conclude that there is no distinction between the various K-particles as regards mass, life-time, and associated production, and that they, therefore, very probably represent different decay modes of the same particles. On the theoretical side, the selection rules have been clearly formulated by Pais in terms of the isotopic spin, but the new quantum number, "strangeness" has not made its appearance.

B. M. UDGAONKAR.

**The Sources of Eddington's Philosophy.** By Herbert Dingle. (Cambridge University Press), 1954. Pp. 64. Price 3 sh. 6 d. (Paper cover.)

While philosophy has always had a profound influence on the development of scientific thought, it is only in the present century, mainly as a result of the theory of relativity and of quantum mechanics, that scientific ideas have started to influence philosophy. It is no wonder therefore that some of the foremost scientists have paid a great deal of attention particularly in their later years, to the philosophical implications of scientific discoveries.

Foremost among those who sought to interpret this aspect of science was Sir Arthur Eddington. It was he who brought out clearly that the theory of relativity required not merely big changes in many of the theories in physics, but a complete reorientation of the objectives of scientific method. The view that physics is the description of the character of the external world was simply no longer tenable. In his view, physics is the result of certain operations performed by the observer, and therefore is necessarily subjective in nature. Thus, instead of starting with a given unknown world and finding out its nature and character by observation, we start with observations and construct a world to satisfy them. However, as Dingle points out, Eddington was far too much of a Victorian to concede that there was no relation between physical quantities and the world, so he made the only possible assumption: physical quantities symbolise the world in some way.

Consequently, in Eddington's philosophy, there is a marked division between what might be called the *nature* and the *structure* of the

external world. All metrical studies give us information only about its structure, which because of relativity, is apprehended only in subjective form. However, there seems to be no limitations imposed on our knowledge of the external world obtained by non-metrical methods, adopted for instance by the artist or the theologian. Thus, the purely objective world is the spiritual world, consisting of life, consciousness, spirit; the material world is subjective in the sense of subjective selectivism.

An aspect of Eddington's philosophy which has caused more controversy than any other is his conclusion that the laws of physics are derivable by pure reason. But as Dingle points (out pp. 42-44), a good part of it is due to a misunderstanding of Eddington's writings. Eddington "distinguishes sharply between the laws of physics and the actual entities among which we find ourselves and which obey those laws... The laws of physics characterise the behaviour of any conceivable physical world and therefore tell you nothing at all about which of the conceivable ones is the actual one." Further, when Eddington says that the properties of external world are deducible from pure reason, he means really the metrical world constructed from our data of observations. Eddington in fact claimed to have done this and obtained a theory unifying relativity and quantum theory, from which he could even deduce the numerical values of a number of fundamental constants.

It is not possible to summarize here all the ideas put forward in this fascinating critical review of Eddington's philosophy. Although terse and at places highly individualistic, the book can be warmly recommended to any one interested in the subject, as it contains one of the clearest expositions of Eddington's scientific philosophy.

#### Introduction to Atomic and Nuclear Physics.

Third Edition. By Henry Semat. (Chapman & Hall), 1954. Pp. xii + 561. Price 50 sh.

Ever since its appearance in 1939, Professor Semat's *Introduction to Atomic Physics* has enjoyed immense popularity with undergraduates and lecturers alike. Written by a teacher of modern physics with several years' experience, the book sets forth in simple and precise language all the essential details of atomic physics, with profuse illustrations and typical problems. Its revision in 1948, particularly in the section on nuclear physics, increased its usefulness considerably. And now

we have a completely revised and enlarged edition of the book, with the title modified to read, "Introduction to Atomic and Nuclear Physics".

Though the change in the title indicates the direction in which the major expansion has proceeded, yet one notices new additions to the text here and there, almost throughout the book. An important feature of this volume (as in earlier editions) that gives it added value as a text-book is the inclusion of a number of problems at the end of each chapter. Several new problems and a short bibliography are included at the end of each chapter of this volume. However, it is a pity that the references are mostly confined to other books, and very few references are made to original papers. At the Honours undergraduate level, at least the more enterprising students should be given an opportunity to refer to original papers on some of the important topics dealt with in the text.

The text has been divided into three major parts, viz., Foundations of Atomic and Nuclear Physics, Extra Nuclear Structure of the Atom and Nuclear Physics. But within these major divisions the chapter subdivisions follow the same general arrangement as in the earlier editions, except that some of the longer chapters have been further subdivided and new sections are added here and there. Some of the important additions to the first part include photo-multipliers, scintillation counters, Cerenkov radiation, wave velocity and group velocity, diffraction of neutrons and electron optics, accompanied by reproductions of electron micrographs. A very valuable addition to the second part is the section on nuclear magnetic moments, describing in some detail methods for the determination of nuclear magnetic moments.

Naturally, the third part of the book contains most of the new additions. Several important nuclear reactions, accompanied by cloud chamber and other photographs, nuclear energy level diagrams and yield curves have been added. Theories of alpha- and beta-decay, as well as evidence for the existence of the neutrino are presented and discussed. A whole chapter is devoted to nuclear fission, and all the different aspects are dealt with in full. Cosmic rays have again received scanty attention, as in former editions; but ample amends have been made by describing in some detail the new fundamental particles—the light and heavy mesons and hyperons—all of which were

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discovered in cosmic ray studies. The section devoted to primary cosmic ray particles includes some very good photomicrographs of two large "stars" and a heavy primary track, illustrating meson jets, pi-mu-e decays and other interesting events. Particle accelerators are fully described in a separate chapter, and details about some of the recent (1954) giant accelerators are given, with photographs and sectional diagrams.

Here is a text-book for the undergraduate student in physics, the usefulness of which has been clearly demonstrated in the first two editions, and which is now presented to us with its value vastly enhanced by revision and enlargement. It is one of those text-books that ought to find a place in every college library where a degree course in physics is offered.

M. A. THANGARAJ.

**Heterocyclic Compounds with Indole and Carbazole Systems—Chemistry of Heterocyclic Compounds. Vol. VIII.** By W. C. Sumpter and F. N. Miller. (Consulting Editor: Weissberger.) (Interscience Publishers), 1954. Pp. 307. Price \$10.00.

As the Preface states, the chemistry of indole had its beginning in the dye industry, and for many years developments in the field were associated with dyes. Extensive accounts of the chemistry of indigo and its derivatives, and also of intermediates and related compounds such as indoxyl and isatin, have therefore appeared in books on the chemistry and technology of dyes. Consequently, one may question the purpose of several of the chapters in the book under review, which incidentally makes no reference to Thorpe and Ingold's *Vat Colours* (1923), Martinet's *Matieres Colorantes des Indigoides* (1934), and more recent publications in the field. Volume 3 of Elderfield's *Heterocyclic Compounds* (Wiley, 1952) has a chapter of 274 pages on indole and its derivatives, including indoxyl, oxindole, isatin, dioxindole, and indigo, and a chapter of 51 pages on carbazole. All these are treated, less satisfactorily on the whole, in the present book. The Elderfield Volume also deals with isoindoles, which are excluded from this volume of the Weissberger series. Excellent chapters on the indole alkaloids (by Marion) and the strychnos alkaloids (by Holmes) have appeared in the Manske-Holmes series covering the alkaloids, and it is doubtful if the present treatment of the same subjects offers any advantage. The chapter on carbazole is not comprehensive and up to date; thus useful information in BIOS

reports and other publications on the isolation of pure carbazole from anthracene oil and the preparation of various carbazole intermediates and dyes (e.g., Hydron Blue) has been ignored. The statements in p. 92 concerning carbazole tetrasulphonic acid neglect the fact that 2-hydroxycarbazole is manufactured from the mixed tetrasulphonic acids.

A methyl group has been omitted from structure (XXXIX) for vomicine (p. 271). In p. 20, line 1, "a, a" should be " $\alpha$ ,  $\beta$ ". There are several errors in the spelling of names, e.g., Seshadre and Tilac.

This is a somewhat disappointing book, and it is too highly priced considering its size and the fact that the contents are largely a duplication of material readily available and more fully treated in other books.

K. V.

**The Law and the Engineer.** By Christopher F. Mayson. (Chapman & Hall), 1955. Pp. 470. Price 63 sh.

Several surveys regarding the faculties required to be developed in the engineer have revealed very interesting results; for instance, the following: "Essential Qualities of a Successful Engineer": 41% character, 17.5% judgment, 14.5% efficiency, 14% understanding of human nature and 13% technical knowledge (Charles R. Gow, *Foundations of Human Engineering*). An increasingly important part of an engineer has now come to be managerial abilities and so in an evergrowing manner Industrial Economics is included as part of the equipment for final Engineering Degree courses. Thus, in actual day-to-day practice of the profession as a builder, or a factory manager, or contractor or a technician-cum-administrator, the engineer also comes up against law and its many interpretations. The book under review is intended to "present to engineers in a practical and understandable manner certain aspects of law as are likely to be of interest and concern to those engaged in the design, manufacture, sale, installation and maintenance and repairs of engineering equipment" in England. It is not a handbook of reference like *Every Engineer: His Own Lawyer*; for, more than describing the legal framework the author is at pains to explain the aspects of law affecting the engineer so as to inculcate a general knowledge of the legal principles involved. For this the author has an advantage over other writers of such works, since Christopher Mayson practised as an engineer before he



studied law and went to the Lincoln's Inn as a barrister.

The book starts with an explanation of the scope and machinery of the civil law, the meaning and forms of evidence and goes on to a discussion of the formation, performance and breach of contracts. It deals with the Agency, Bailments, Agreements and other forms of contract, including Monopoly and Trade Alliances. Finally, in the sphere of management, it takes up the Law of Negligence, Factory Acts and Regulations and Employers' responsibilities and liabilities. Useful appendices are given on: (1) Responsibility of professional engineers, (2) Standard conditions of engineering contracts, (3) Summaries of the Factory Act, Statutory Regulations and Acts of Parliament and a table of cases. For all these reasons Indian readers too will undoubtedly find the work informative and helpful. As stated by Lord Justice Denning in his Foreword: It should "give the engineers sufficient knowledge of law to be able to deal with simple points and even more important to know when they should seek expert legal advice".

M. C. MUNSHI.

#### Recent Progress in Hormone Research, Vol. XI.

Edited by Gregory Pincus. (Academic Press, New York), 1955. Pp. viii + 518. Price \$ 10.00.

The eleventh volume of the *Recent Progress in Hormone Research* is a record of the Proceedings of the Eleventh Laurentian Hormone Conference held at Mont Tremblant, Quebec, in 1954, and maintains the high standard set by the first ten volumes of this series. The verbatim transcription of the critical discussions at the end of each chapter, gives a realistic account of the Conference, especially for those who were not present at those meetings.

The fourteen chapters are grouped into the following six sections: (i) Pituitary Hormones, (ii) Steroid Chemistry and Biochemistry, (iii) Hormones and Abnormal Growth, (iv) Hormones and Aging in Man; (v) Mechanism of Hormone Action, and (vi) Hormone Cardiovascular Interrelations. The section relating to hormone and aging in man will be of particular interest to medical men and clinical biochemists since geriatrics has assumed as much importance as pediatrics as a medical subject. This section consists of two papers, one on 'Aspects of Aging as Reflected in the Human Ovary and Testis' by E. T. Engle and the other on 'Steroid Metabolism in Aging Men and Women' by G. Pincus and others. The short

review by Engle followed by a lengthy discussion gives a good appraisal of the available histological data on the subject. Pincus and his colleagues give a summary of their earlier work, where they have studied the excretion of different urinary steroids in a group of normal healthy men and women. The changes in individual urinary steroids with age have been studied in great detail and the data fully discussed. They have also studied the influence of steroid replacement therapy on the urinary 17-ketosteroid patterns in old age.

In the section on hormones and abnormal growth, the pathogenesis and character of different hormones secreting transplantable pituitary tumours in mice have been described by Jacob Furth, while Rauson and Rall present a review of studies on certain endocrine factors that appear to control the growth of cancer of breast, tumours of the uterus, carcinoma of the prostate, lymphomatous tumours and tumours of the thyroid.

The section on hormone cardiovascular interrelations is also of considerable clinical interest. The dietary and hormonal factors in experimental atherogenesis and blood pressure regulation have been investigated by Stamler and others with encouraging results especially with regard to the role of estrogens in preventing recurrences of myocardial infarctions. The interesting paper on the two new hepatorenal vasoactive principles, VEM and VDM by Shorr and others deals with their tissues of origin and their intermediary metabolism. Also, the details have been given of the isolation and identification of VDM, its biological actions and of studies on factors involved in maintaining the integrity of the renal VEM and hepatic VDM systems.

Among other articles the recent progress in methods of isolation, chemistry and physiology of aldosterone has been well described by Simpson and Tait. A detailed paper on the role of micro-organisms in bringing about transformation of available steroids into desired cortical hormones has also been ably presented by Fried and his co-workers. Further, the two papers in the section on mechanism of hormone action deal mainly with insulin and carbohydrate metabolism.

There is included in the end, a useful cumulative index for the first ten volumes of this series. The volume on the whole is very well got up and should prove extremely useful to every biochemist and medical research worker who is interested in the progress of hormone research.

V. SRINIVASAN.  
P. S. SARMA.

**Advances in Enzymology**, Vol. XVI. Edited by F. F. Nord. (Interscience Publishers), 1955. Pp. 584. Price \$11.0.

The present volume contains eight articles with cumulative author- and subject-index for volumes one to sixteen. The first article by J. Baddily contains a review of the isolation and the structure of co-enzyme A established by chemical, enzymic and microbiological methods. The next article on the coagulation of blood, written by W. H. Seegers, presents the facts about the various components taking part in the coagulation of blood in the clearest possible manner. H. S. Mason discusses the comparative biochemistry of the phenolase complex and its role in the formation of flower pigments, flavanoids, lacs, tannins, alkaloids, melanins and lignins. A comprehensive account of the transamination reactions and of the mechanism and role of transamination in amino acid metabolism, presented by A. Meister, will demand and repay the reader's earnest attention. In the article on "Intermediates in Amino Acid Biosynthesis" contributed by B. D. Davis, the author has discussed the role of a large number of intermediates and the enzymes in the biosynthesis of  $\alpha$ -amino acids. A thoughtful article on "Myosin" by Szent-Gyorgyi, provides a complete survey of the structural and functional aspects of myosin. The article on " $\beta$ -glucuronidase" contributed by W. H. Fishman sets out the distribution and properties of mammalian, bacterial, plant, insect and mollusc  $\beta$ -glucuronidase followed by a discussion in detail on the facts concerning its histochemistry, and the role of the enzyme in physiology and in relation to disease. The volume concludes with an article on the chemistry of the cell nucleus contributed by Allfrey, Mirsky and Stern, in which the authors have presented a critical survey of the procedures used in these investigations and a detailed account of the nucleic acids, proteins and enzymes of the nucleus.

The articles written by leading workers in their fields cover subjects of considerable topical interest on which adequate reviews for the general reader are not readily available. The contributors are to be congratulated on the careful sifting of material and clarity of exposition. The publishers have fully maintained their reputation for the excellence of printing and production. The book can be warmly recommended to all enzymologists, biochemists and those interested in these subjects.

K. V. GILL

# Books Received

**Advances in Carbohydrate Chemistry**, Vol. X. Edited by Melville L. Wolfrom and R. Stuart Tipson. (Academic Press), 1955. Pp. xx + 437. Price \$10.50.

**Advances in Veterinary Science**, Vol. II. By C. A. Brandly and E. L. Jungherr. (Academic Press), 1955. Pp. xii + 449. Price \$10.00.

**Society of Biological Chemists, India—Silver Jubilee Souvenir**, 1955. (Published by the Society of Biological Chemists, India), 1955. Pp. vii + 262.

**Recent Research on Vitamins**. (Medical Dept. The British Council, 65, Davies Street, London W. 1), 1956. *British Medical Bulletin*, Vol. XII. Pp. 90. Price 15 sh.

**Iron Ores of India**. By M. S. Krishnan. Indian Association for the Cultivation of Science, Calcutta-32), 1955. Pp. 177. Price Rs. 5.

**Methods in Enzymology**, Vol. II. Edited by S. P. Colowick and N. O. Kaplan. (Academic Press), 1955. Pp. xx + 987. Price \$23.80.

**A Symposium on Inorganic Nitrogen Metabolism: Function of Metallo-flavoproteins**. Edited by William D. McElory and Bently Glass. (The Johns Hopkins Press, Baltimore-18, U.S.A.), 1956. Pp. xi + 728. Price \$10.00.

**Advances in Protein Chemistry**, Vol. X. Edited by M. L. Anson, Kenneth Bailey and John T. Edsall. (Academic Press), 1956. Pp. viii + 425. Price \$9.00.

**Thermodynamics and Statistical Mechanics—Lectures on Theoretical Physics**, Vol. V. By Arnold Sommerfeld. (Academic Press), 1956. Pp. xviii + 401. Price \$7.00.

**Polymyxin, Neomycin and Bacitracin—Antibiotics Monographs**, No. 5. By Ernest Jawetz. (Interscience Publishers), 1956. Pp. 96. Price \$4.0.

**Kernmomente**. Second Edition. By H. Kopfermann. (Akademische Verlagsgesellschaft mb, Frankfurt am Main), 1956. Pp. xvi + 463. Price DM 54.

**Non-Ferrous Metal Industry in Europe**. (Organisation for European Economic Co-operation, 2, rue Andre-Pascal, Paris-16<sup>e</sup>). Pp. 92. Price \$1.00.

**Reduction with Complex Metal Hydrides**. By Norman G. Gaylard. (Interscience Pub.), 1956. Pp. xvi + 1,046. Price \$15.00.

**Polymer Processes—High Polymers**, Vol. X. Edited by C. E. Schildknecht. (Interscience Pub.), 1956. Pp. xvii + 914. Price \$19.50.

## APPLIED BIOLOGY\*

THE volume of the journal, under review, is the Proceedings of the Silver Jubilee Meeting of the Association of Applied Biologists held in London during September 1954. It contains 39 articles devoted to various aspects of the biological sciences. These articles have been classified under eleven heads.

Among the articles of general interest is one by Sir John Russell on "The Changing Problems of Applied Biology". Sir John Russell has pleaded for close co-operation between the specialists of all branches of biology. He has dealt with the prodigious developments in the various sciences like development of synthetic chemical industry, systematic insecticides and fungicides, antibiotics, growth-promoting substances, etc. He rightly states that 'these new substances, the new insecticides, fungicides, plant hormones, herbicides and others give great powers of control but they also raise a host of new problems'. The modern applied biologist is a specialist dependent on the statistician, the chemist, the physicist and others for a proper understanding of this intricate problems. Specialisation leading to lack of proper co-ordination of the different branches is likely to hamper advancement. The Jubilee Meeting of the Association has pre-eminently served the purpose of bringing together outstanding specialists in the different branches of Applied Biology.

The need for International co-operation in combating plant diseases and pests has been forcibly brought out in the three articles under the heading "International Co-operation in the Field of Crop Protection". A strong plea to avoid overlapping of the activities of the different commissions sponsored by UNESCO, E.P.P.O., F.A.O., W.H.O., etc., has been made for a more efficient working of the International Crop Protection Schemes.

The three articles on the problems of food storage and insect pests of stored products deal with the importance of proper storage conditions not only for the good of the farmer, but also for a sound national economy. Stress is laid and correctly on the fact that the prestige of a station is likely to be lowered through marketing insect damaged foodgrains.

A review of the research work so far done on plant virus diseases and their spread and control has been brought out in the four arti-

cles dealing with plant viruses and virus research. The electron microscope has enabled us to see and study the viruses which for so long have been invisible and rapid advances have been made in the study of plant virus. Yet much work remains to be done on the exact mechanism of virus multiplication in the cell. Plant breeders have played an important part in the evolution of virus-resistant strains. More recently 'tissue culture' has afforded a promising way of obtaining virus-free plants from infected stocks.

Considerable advance has been made in the field of plant hormones and selective weedicides. Ever since the identification of indole acetic acid as a plant auxin, a number of synthetic compounds have been introduced into the market. These substances have been of use in rooting of cuttings, inhibition of bud growth, initiation of parthenocarpic fruit production, for prevention of the drop of immature fruit, for acceleration of flowering of pineapples and for weed control. The most modern hormone which seems to act as a panacea for all ills is 2-4 D. There are four interesting articles on this aspect.

The need for education and training in applied biology has been forcibly brought out in the three articles relating to "Education and Extension Services in Applied Biology". This subject has been discussed by the President, Prof. Brown, himself. The lower status given to the research worker in applied science as compared to his counterpart in pure science has been strongly deplored. The correct approach to biological education for agricultural research has been well discussed by Prof. Brown.

Problems of applied zoology, especially biological control of insect pests, have been discussed in three articles. Taylor has ably summarised the various aspects of biological control and summarises in the end that it is the best of all methods of controlling pests but seldom works, and there is little future for it in continental areas. It is to be considered whether in these days of chemical control methods, the biological control, with its limited scope, is really comparable with the former in efficacy and cheapness.

The volume covering all aspects of applied biology brings out clearly the complexity of any biological problem and the need for co-ordination of different branches for their solution.

N. L. DUTT.

\* *The Annals of Applied Biology* (Vol. 42) (Cambridge Univ. Press), 1955. Pp. ix+414. Price 25 sh.

## SCIENCE NOTES AND NEWS

### Zonate Leaf-spot Disease of Jowar

R. K. Singh and H. H. Prasad, Central Sugarcane Research Station, Pusa, Bihar, write that during September 1955, leaves of six varieties of *Sorghum*, namely, MM 9, MN 48, Rex, Sart, Sorgo strain C-041 and Sorgo strain R 615 varieties were found to suffer from zonate leaf-spots caused by *Glæocercospora sorghi* Bain and Edgerton, the incidence of the disease being 1.0-45.0% on plant basis. Previously the disease has been reported from U.P. (R. K. Singh, *Thesis*, Agra 1948) on jowar and from United States [D. C. Bain and E. W. Edgerton, *Phytopath.*, 1942, 32, 1; 1943, 33, 220] on *Sorghum*, maize and sugarcane, etc. The filiform spores formed in spots and in culture measured  $28.5-89.1\mu$  (average  $54.1\mu$ ) in length and  $1.8-2.8\mu$  (average  $2.3\mu$ ) in breadth. This is the first record of the disease from Bihar.

### Expanding Universe

The theory of the expansion of the universe rests observationally on Hubble's law, which shows that galaxies in space are receding from each other with velocities that are proportional to their distances apart. Evidence for this red shift law rests on observations obtained only in the narrow visible portion of the wide electromagnetic radiation spectrum that impinges on the earth's atmosphere.

The observed red shifts have been attributed to Doppler effect, in which case the wavelength shift divided by the wavelength used should be constant anywhere in the electromagnetic spectrum. The spectral line at a wavelength of 21 cm. (arising from hydrogen gas in interstellar space) offers a test for this interpretation. Hydrogen absorption measurements carried out by Lilley and McClain on the Cygnus source establish the constancy of the red shift over a base line of 50,000 to 1 in the electromagnetic spectrum. This constancy is a natural consequence of the Doppler interpretation giving it strong support.

### New Synthetic Hormone

John A. Högg *et al.* have announced a new synthetic hormone nearly three times as potent as aldosterone (*J. Amer. Chem. Soc.*, 1955, December 25 issue). The new hormone is a methyl derivative of fluorohydrocortisone ace-

tate and is more effective than any other known substance in stimulating the body's retention of salt, an ability that is characteristic of some adrenal cortical hormones.

A second methyl hormone is also reported in the same article. This substance, named 2-methylhydrocortisone acetate, is ten times as active as hydrocortisone in the glycogen deposition assay.

### Technology of Fish Processing

An International Meeting of Fish Processing Technologists, organised by the FAO, is to take place at Rotterdam, Netherlands, from 25 to 29 June 1956, at the invitation of the Netherlands Government. The meeting will be open to any fishery technologist who wishes to attend.

Dr. G. A. Reay of the United Kingdom will be Chairman of the Meeting and the Chairman of the four committee working groups—Mr. F. Bramsnaes of Denmark, Mr. K. Bakken of Norway, Professor George Borgström of Sweden and Mr. E. Heen of Norway—will present their reports on chilling and freezing of fish, fisheries products for tropical consumption, and prepackaged fisheries products. A Symposium on the Chilling of Fish will be held during three days of the Meeting. The Symposium will deal with the use of antibiotics, bacteriostatic ices and dips, brine cooling, sea-water ice, scale and crushed ice, and fresh fish quality assessment, using organoleptic and objective methods.

Fishery technologists who wish to attend the meeting should notify the Secretary of the Interim Committee, Dr. Hess, Chief, Technology Branch, Fisheries Division, FAO, Rome.

### Endeavour Prizes

The Imperial Chemical Industries (Publishers of the quarterly scientific review *Endeavour*) have offered the sum of 100 guineas to be awarded as prizes for essays submitted on a scientific subject. The competition is restricted to those whose twenty-fifth birthday falls on or after 1st June 1956. The subjects for the essays are as follows: Research in Polar Regions; Scientific Aids to Archaeology; The Story of Steel-Making; The Chemistry of Big Molecules; New Elementary Particles; The Control of Plant Diseases. The essays, which must be in English and typewritten, should not exceed 4,000 words in length, and only one



entry is permitted from each competitor. Essays must be submitted without signature. The competitor's full name and address and date of birth should be disclosed in a sealed covering letter attached to the essay and addressed to: The Assistant Secretary, British Association for the Advancement of Science, Burlington House, Piccadilly, London, W.1, and must be received before June 1, 1956.

#### European Federation of Chemical Engineering

The European Federation of Chemical Engineering was founded in 1953 and, at the moment, consists of 24 Member Societies from 13 different European countries. The Federation has been extremely active in the short period of its existence. The Federation held its First Congress in 1955 in Frankfurt am Main, which was attended by no less than 12,150 personally registered visitors from 53 different countries.

A further result of this close co-operation of technical and scientific societies in the chemical engineering and equipment fields is the careful co-ordination of forthcoming important events in this sphere of activities. Details of the events for 1956 are as follows: 7-8 June, 1956, Frankfurt am Main: 31st Annual Congress of the *Dechema*; 1-3 October, 1956; Hamburg: Annual Meeting of Process Engineers; 22-24 November, 1956, Paris: Symposium on Special Themes.

The organising bodies may be approached for all further details concerning the events and functions listed above.

Prof. G. B. B. M. Sutherland

Prof. G. B. B. M. Sutherland, Professor of Physics, and Director of the Biophysics Research Centre in the University of Michigan, has been appointed Director of the National Physical Laboratory, U.K. Prof. Sutherland is a leading authority on infra-red spectrum analysis but of recent years has taken special interest in the field of biophysics. In 1947 he became Reader in Spectroscopy at Cambridge and in 1949 was appointed to his present post in the University of Michigan. He was elected a Fellow of the Royal Society in 1949.

#### Madras University Prizes

**The Maharaja of Travancore-Curzon Prizes for 1956-57.**—Two prizes, one for Archaeology and one for Bacteriology, will be awarded by the Syndicate for the best essay or thesis written by any graduate of the Madras University on any topic dealing with the subjects. The value of each prize is Rs. 250. Competitors

should submit their theses so as to be received by the Registrar not later than the 1st March 1957.

#### Sir William Wedderburn Prize, 1957.—

The prize which will consist of books of the value of Rs. 45, will be awarded to the student, who, having qualified in chemistry for the Degree of B.Sc. (Honours) or M.Sc. not more than two years previously, has shown aptitude for research. A thesis on any research work conducted by the student should be submitted with the application so as to be received by the Registrar, University of Madras, not later than the 30th April 1957.

#### Directory of Aluminium, 1955

An attractively got-up brochure on Aluminium has been published by the India Section of the Electrochemical Society, Bangalore-3, under the editorship of Dr. N. R. Srinivasan. The brochure has three sections: The technical section comprises articles on various aspects of aluminium among which mention may be made of: The History of Aluminium, by V. Ramachandran and N. R. Srinivasan; A Perspective of the Indian Aluminium Industry, by Mahesh Chandra; Aluminium in Telecommunication Industry, by S. Krishnamurthy; Some Aspects of Aluminium Research in India, by E. G. Ramachandran. The reference section gives physical and chemical data which will be of much use to industrialists, as well as information on patents, standards and current researches on various aspects of the metal. The Directory Section contains the names and addresses of industrialists and manufacturers dealing with aluminium from the ore stage to the finished product.

The venture is a laudable one and deserves support from the Government, industry, trade, and research workers.

#### Award of Research Degree

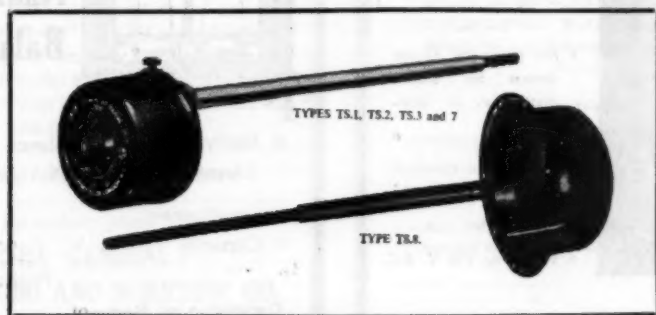
The University of Bombay has awarded the D.Sc. Degree in Botany to Sri. V. S. Rao for his thesis entitled, "Studies in the Floral Anatomy and Floral Morphology of the Bicarpellatae and Some Other Families of Angiosperms".

The Nagpur University has awarded the D.Sc. Degree in Zoology to Dr. B. S. Chauhan for his thesis related to "Studies on Indian Fauna".

The Delhi University has awarded the Ph.D. Degree in Botany to Sri. R. Narayana, for his thesis entitled "Morphological and Embryological Studies in the Family Loranthaceae-Loranthoidae".



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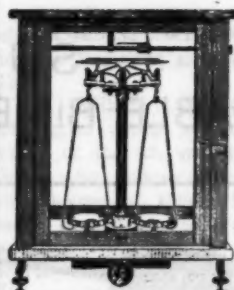
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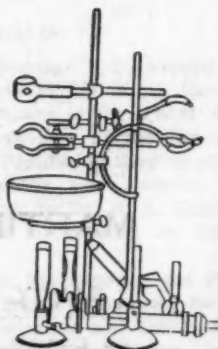
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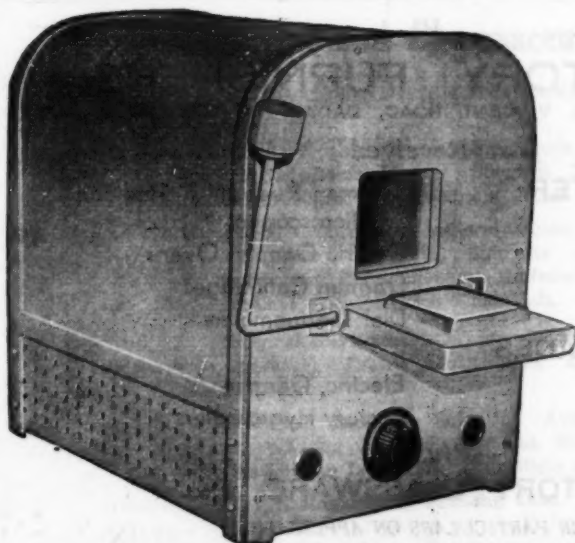


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